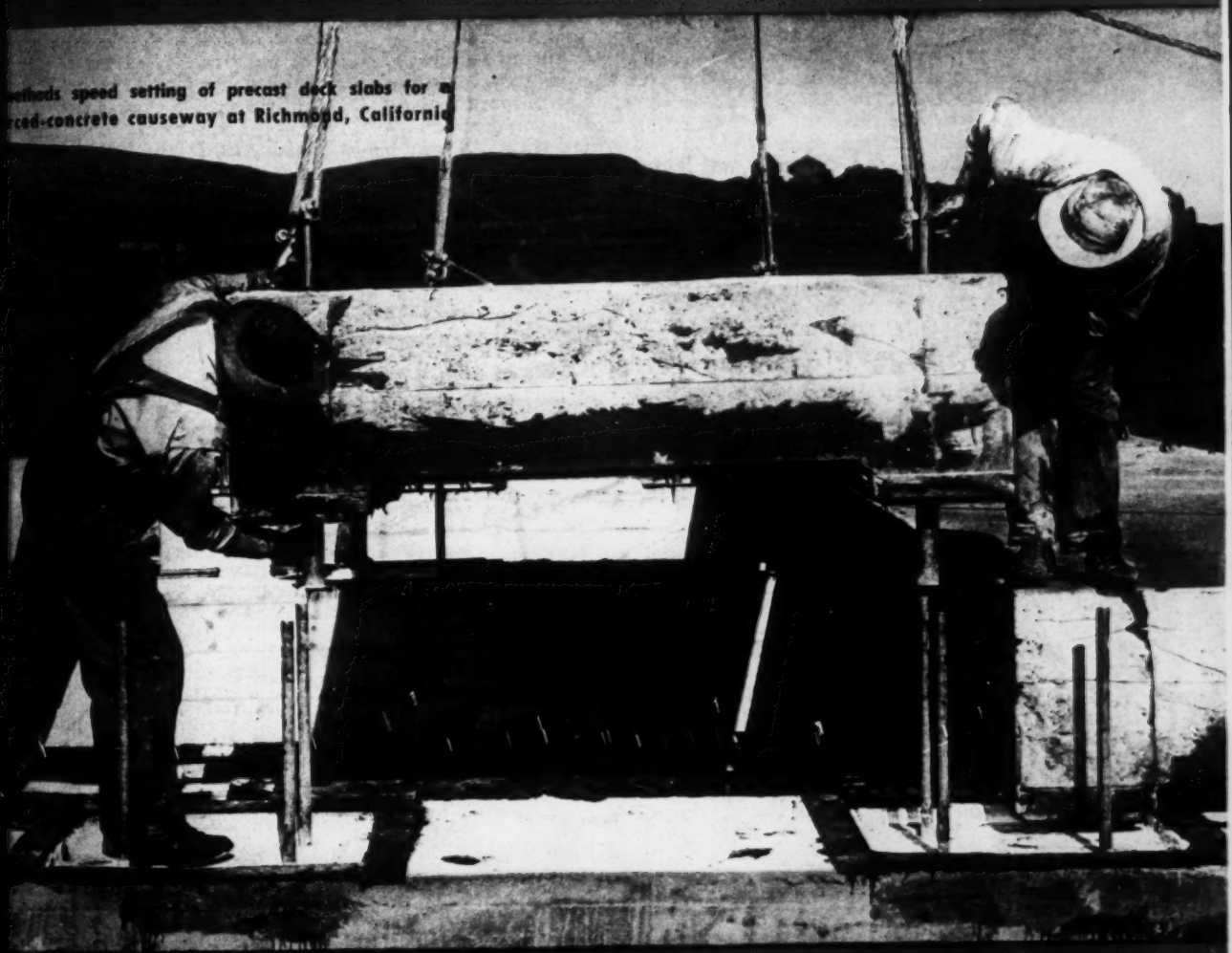
ENGINEERING NEWS-RECORD

NOVEMBER 28, 1946



...thods speed setting of precast deck slabs for ...
...ced-concrete causeway at Richmond, California

In this issue:

PILE FOUNDATIONS FOR CHICAGO PRINTING PLANT

[illegible] BUILDING PRACTICES IN [illegible]

PREVENTIVE MAINTENANCE FOR HIGHWAY EQUIPMENT

Byers Snow Melting Systems predict "Open winters" for driveways

The "Winter-proofed" driveway at the American Cyanamid Company plant, Bridgeville, Pa., suggests an ingenious solution to a problem that is frequently encountered.

A two-lane, 600-foot roadway runs up-grade from the parking area to the main thoroughfare, and the lightest fall of snow, or the least bit of icing, would cause complications. The engineers—after hearing of the success of Byers Snow Melting Systems in loading areas and side walks—installed 8 lengths of Byers Wrought Iron Pipe, so positioned as to locate two pipes 18-inches apart under each wheel track. The runs extend the entire length of the roadway, and are welded into 4-inch wrought iron headers at each end. The entire system is embedded in an 8-inch concrete slab.

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The question of corrosion had an important bearing in designing the driveway itself, as the engineers were anxious to avoid the use of a gravel foundation. Tests made by A. M. Byers laboratory revealed acid soil in certain areas. After weighing the opposing factors . . . good drainage provided by the grade, the alkaline properties of the cement, and the known corrosion-resistance of wrought iron . . . the slab was laid directly on graded earth.

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You will find some helpful information on snow melting in our Case Study No. 4, "A Study of Snow Removal." Ask for a copy.

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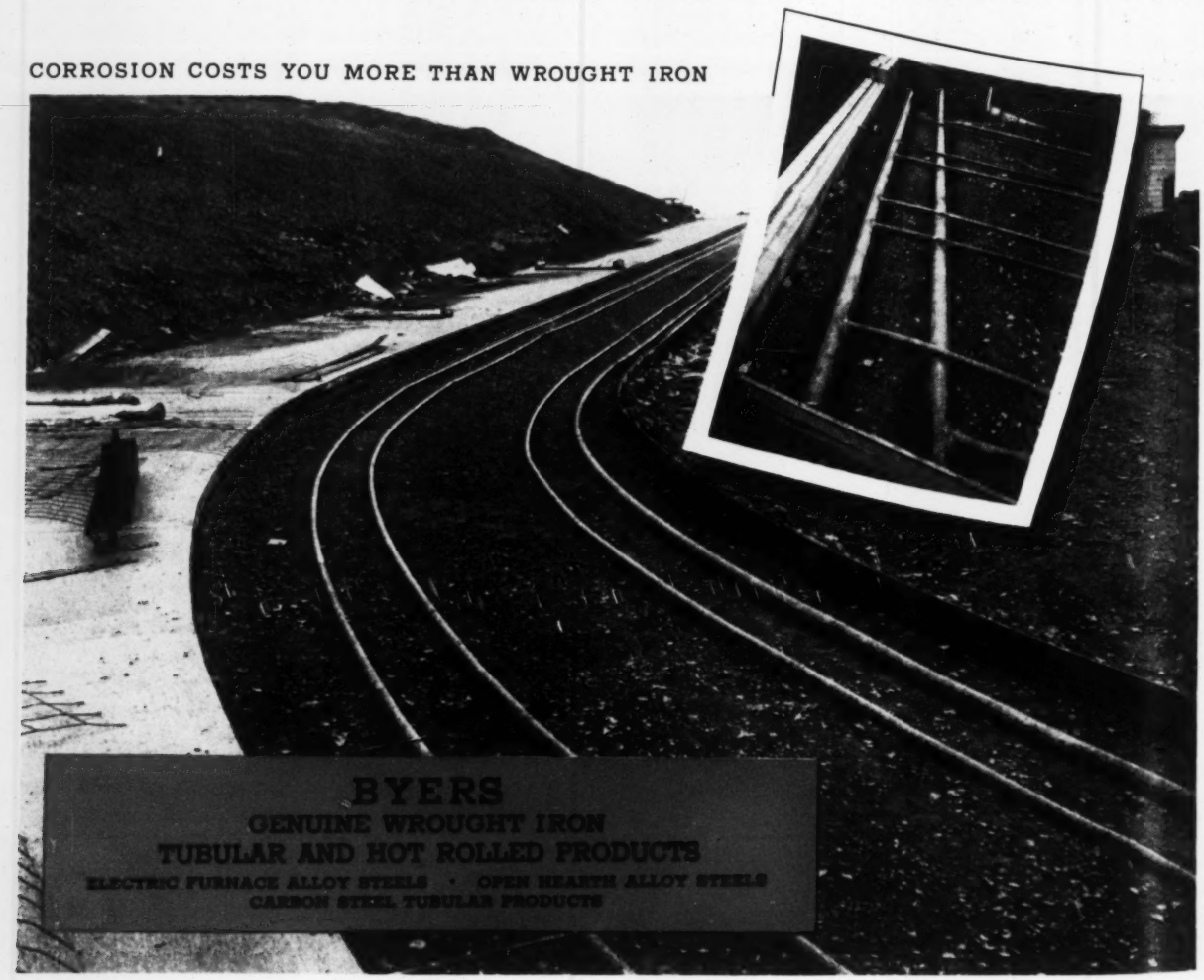
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Volume 137 • Number 22 November 28, 1946

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ENGINEERING NEWS-RECORD

Published By

McGRAW-HILL PUBLISHING CO., INC.

Publication Office:

99-129 N. Broadway, Albany 1, N. Y.

Editorial and Executive Office:

330 W. 42nd St., New York 18, N. Y.

ABC member ANPA

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Number of Copies of this issue printed 42,811

ENGINEERING NEWS-RECORD. Published every Thursday. **Return postage guaranteed.** Vol. 137, No. 22. Price 35c per copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd Street, New York 18, N. Y. Subscriptions, United States and U. S. Possessions, $6.00 for one year, $9.00 for two years, $12.00 for three years. Canada $7.00 for one year, $11.00 for two years, $14.00 for three years. Latin American countries $10.00 for one year, $16.00 for two years, $20.00 for three years. All other countries, $20.00 for one year, $30.00 for two years, $40.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in the U.S.A. Cable Address: "McGraw-Hill New York." Member A.B.P. Member A.B.C.

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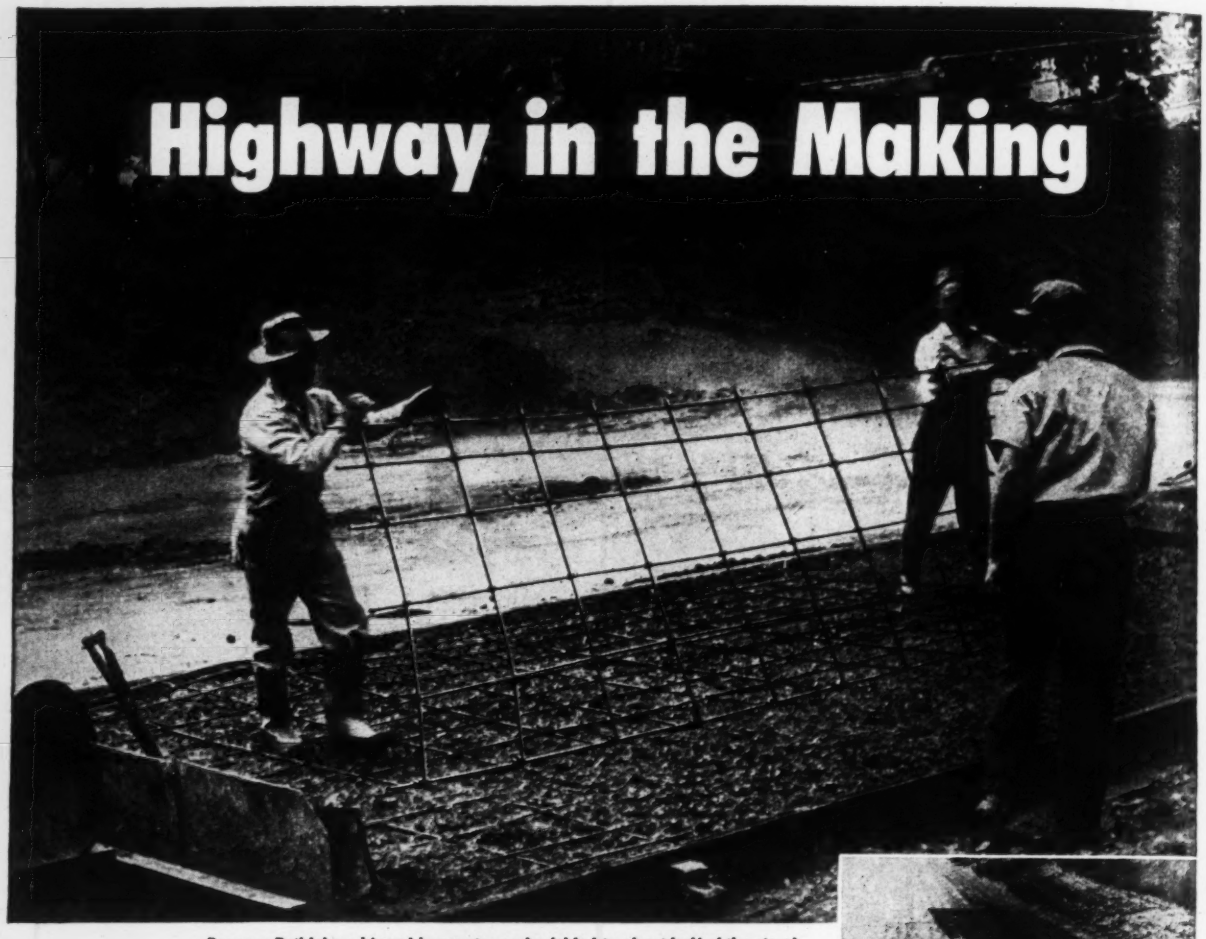
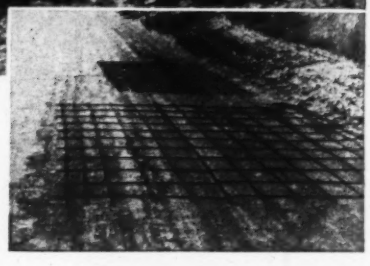
Highway in the Making



Because Bethlehem hinged bar mats can be folded to about half of the standard mat size, they can be handled by two men, and easily trucked without exceeding the road-width limit set up by state highway departments.



These on-the-job photographs were taken near Avon, N. Y., during construction of a six-mile, two-lane stretch of Route 5—through highway from Albany westward to Buffalo. Built for New York State Division of Highways by the Potter-DeWitt Co. of Pavilion, N. Y., this new section required 62,000 sq yd of concrete. Bar mats and other steels for the job were furnished by Bethlehem.

Many contractors regularly turn to Bethlehem whenever they need steel to build a highway or highway bridge. Bethlehem steel service saves time and money. You can obtain from this one source practically every type of steel needed to build a modern highway or bridge. And Bethlehem handles your order as a unit, with individual items scheduled to reach the job when needed. You avoid a lot of needless follow-ups, and minimize bookkeeping.

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STEEL for HIGHWAYS

BETHLEHEM STEEL

Construction Trends

Construction Wages and Material Prices Level Off

The sharp rise in wage rates and material prices measured by the *ENR* construction and building cost indexes, was halted in August. During the months of September, October, and November, the construction cost index averaged a monthly gain of only $\frac{1}{3}$ of one point, while the building cost index increased $\frac{2}{3}$ of one point per month.

During the war years of 1939 through 1945, the weighted indexes revealed average annual increases ranging from 7 to 12 points, while contractor indexes rose 6 to 14 points. Weighted indexes, which measure wages and material prices only, rose as follows: *ENR* building cost index, 7; Associated General Contractors, 7; E. H. Boeckh, 7½; American Appraisal Co., 12; and *ENR* construction cost 12 points. Contractor indexes reflected greater increases due to the inclusion of "hidden" cost elements, such as overtime wage payments, low productivity, material and labor shortages, and job delays from other causes. Fruin-Colnan Index rose 6½ points; George A. Fuller, 7½; Aberthaw, 7½; Turner, 13½; and Austin, 14 points.

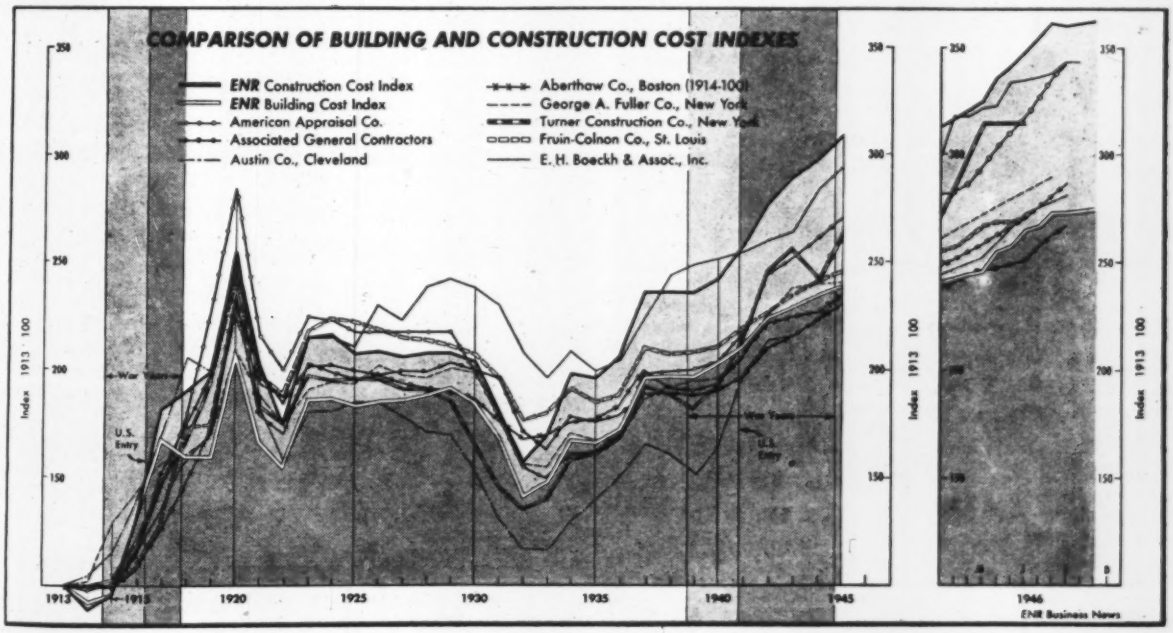
No steep rise in construction costs occurred until three months after the War's end. Then, starting in December, 1945, and continuing through August, 1946, American Appraisal Co. index rose 56 points; *ENR* construction cost, 52; E. H. Boeckh, 38; *ENR* building cost, 31; and Associated General Contractors, 25. All of these nine-month gains far exceeded the twelve-months gain of the average War year.

The current levelling-off of construction costs is apparent from consideration of the *ENR* construction and building cost indexes, which have been computed through November of this year. The construction cost index rose an average of 6 points per month during the first eight months of 1946, but dropped to an increase of only $\frac{1}{3}$ of one point per month in the last three months. The *ENR* building cost index rose 4 points per month through August, but is gaining only $\frac{2}{3}$ of one point at the present time. Since most of the contractor indexes are computed quarterly, it is impossible to judge their rate of gain in the last three months.

This is written just after the lifting of OPA ceilings, but before the effect of this action can be determined.

HISTORICAL RECORD OF CONSTRUCTION COST INDEXES — 1946

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
WEIGHTED INDEXES											
ENR Construction	316	320	324	335	340	348	354	361	360	361	362
ENR Building	242	244	245	254	257	264	266	272	272	273	274
American Appraisal	283	286	294	303	310	317	326	335	342	...	...
Associated General Contractors	241	244	246	247	249	251	258	263	267	...	...
E. H. Boeckh	317	317	321	322	333	334	335	337	343	343	
CONTRACTOR INDEXES											
Aberthaw	...	...	258	...	...	270	...	...	287	...	...
George A. Fuller	...	...	...	...	...	...	...	290	...	...	...
Turner	...	...	314	...	...	314	...	...	...	...	...
Fruin-Colnan	257	261	266	268	268	270	...	...	...	...	...
Austin	...	...	252	...	...	272	...	...	281	...	...



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News of the Week

ENGINEERING NEWS-RECORD • NOVEMBER 28, 1946 • VOLUME 137 • NUMBER 22

Seek formation of national construction research group

Construction Advisory Council recommends steps for strong organization to coordinate industry's work—Asks removal of remaining construction controls

Major steps towards creation of a strong national research organization for the construction industry were taken at the 2-day meeting of the Construction Industry Advisory Council in Washington, D. C., last week under auspices of the U. S. Chamber of Commerce. After being told that supplies will soon become more plentiful but that costs will remain high for a time, the council also voted for complete removal of controls on construction.

This meeting was the second for the council, which was organized over a year ago. John C. Stevens, former president of the American Society of Civil Engineers and consulting engineer with offices in Portland, Ore., is chairman of the group, which represents about 100 national trade and professional associations.

The great need for a research organization assisting all of the various phases of construction was first outlined in a report prepared by Eric A. Johnston, former president of the Chamber of Commerce of the U. S. and chairman of a special 11-man committee set up to evaluate the need for research for the industry.

Organization proposed

The committee reported that much good research had been done in specialized fields in the industry but that no one group was interested in all the various problems and that there was a great lack of coordination of technical findings. It was concluded that if industry itself does not act, the government would organize to do the job but that cost would be much higher.

After praising highly the Highway Research Board in its work under the supervision of the National Research Council, the committee recommended that a similar organization be established on an industry-wide basis.

A board with two major divisions was proposed. At the top, with the general function of determining policies and exercising broad supervision, would be a committee of representatives from all elements of the construction industry, including, but not necessarily limited to, designers, contractors, suppliers, and financial agencies. Government construction and research agencies would also be represented.

Subordinate to this group, and charged with responsibility for carrying out its directions, would be a permanent staff of highly qualified experts headed by a director. The size and composition of this staff would be determined by the extent of the program planned. The committee recommended that this staff should contain a director, an educational director to operate an information center, and experts thoroughly conversant with construction techniques and economics. Additional staff members would be added as rapidly as the need for them is established.

A $500,000 research program calling for a minimum expenditure of $100,000 annually for the next five years is being considered. Satisfactory financing of a program of this size by obtaining pledges from all of the elements of the industry is believed possible. Steps were taken toward setting up the machinery to carry out such a plan.

Discussion of the need for research also brought praise for the work of the

(*Continued on p.* 38)

Southern builders favor new standard code

Support for regional adoption of a new Southern Standard Building Code was strong at the recent annual Southern Building Code Congress at New Orleans, La. M. L. Clement, permanent director of the congress, who supervised writing of the code published last July, said more than 30 of the 72 member cities have already adopted the new building rules.

Government and industry speakers at the convention gave the effort hearty endorsement. B. L. Wood, consulting engineer for the American Iron and Steel Institute, told the building officials that the South will experience a program of "face-lifting" in every city, as higher standards of living will bring demands for better shops, theaters, offices and homes.

Mayor J. Herbert Meighan, of Gadsden, Ala., who was re-elected president, pointed to the "antiquated" codes in many Southern cities and asserted that their continuance will mean the waste of millions of dollars during the expected industrial expansion.

J. W. Morgan, commissioner of public improvement, Birmingham, Ala., was re-elected vice-president.

Forty-four new standards reported at ASA meeting

Indicating the great interest in industrial standards and the desire for a speedy upturn in industrial production and the revival of building, there was a record attendance of 500 at the 28th annual meeting of the American Standards Association in New York City, Nov. 21 and 22.

It was reported at the meeting that 31 new regular standards were approved in the last year, and 13 revised, making a total of 44. Said to be the most important is the national electrical code developed under the leadership of the National Fire Protection Association to govern the installation of electrical wirings, switches, outlets, and other devices in practically all buildings in the United States.

The new American standard for modular sizes of masonry units, coupled with two standards approved a year ago, provide the building industry with means to facilitate speed and economy.

Officers elected for the ensuing year include: President, Frederick R. Lack, vice-president of the Western Electric Co., who succeeded Henry B. Bryans; and vice-president, George H. Taber, Jr., of the Sinclair Refining Co.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction—A $1,000,000 hotel is planned for *Spartanburg, S. C.* . . . Monsanto Chemical Co. has received government approval for a $4,000,000 plant expansion at *Monsanto, Ill.* . . . C.P.A. has approved construction of a $2,530,000 factory for the American Radiator Co. at *Torrance Calif.* . . . A 10-year $3,000,000 school building program is being considered at *Salt Lake City, Utah.* . . . A $2,000,000 new building program has been announced for the *Cleveland, Ohio,* Catholic diocese. . . . Braunstein's Inc., *Wilmington, Del.,* will build a new million dollar department store. . . . Petrol Corp. will build a million dollars' worth of service stations in the *Philadelphia, Pa.* area. . . . The Sun Oil Co. will build 42 gasoline service stations to cost $1,250,000 in the eastern and northeastern *United States.* . . . *New Jersey* has plans nearing completion for a $2,000,000 state office building. . . . North American Mutual Ins. Co., will build a $1,200,000 office building in *Wilmington, Del.*

Housing—General Home Builders, Inc., has a $500,000 development at *West Trenton, N. J.* . . . Kinder and Furmas, *Eddystone, Pa.,* $1,000,000. . . . Bermark Co., *Philadelphia, Pa.,* $1,000,000. . . . P. R. Roberts, *Media, Pa.,* $1,000,000. . . . Howard C. Kinder, *Springfield, Pa.,* $1,000,000. . . . Benj. F. Weiss, *Philadelphia, Pa.,* $1,000,000. . . . Collins Development Co., *Brandywine Hundred, Del.,* $1,000,000. . . . A government-guaranteed contract has been awarded to the Knox Corp. of *Thomson, Ga.,* for 6,000 prefabricated wood-plywood houses by the end of 1947. . . . The city council of *Toronto, Ont.,* is asking the dominion government to build 400 dwelling units for emergency cases in the Toronto area this winter.

Highways—*Delaware* State Highway department will re-advertise for more than $300,000 of road work, high bids having been rejected. . . . As the *Baltimore, Md.,* budget now stands, $2,625,000 would be available in 1947 for new streets, highways and bridges; another $2,000,000 for replacements and $1,951,000 for repairs. . . . Alexandra Bridge, *Ottawa, Ont.,* has been reopened to traffic between Ottawa and Hull.

Miscellany—A plan for the construction of tunnels under business streets in *Charlotte, N. C.,* to provide parking space for 1,000 cars has been proposed by Martin E. Boyer, Jr., a Charlotte architect, who estimates that the project would cost $2,600,000 and require 700 linear feet of tunneling. . . . A $17,000 advance for preparing plans and specifications for a $635,000 river-rail terminal on the Mississippi River is reported granted to the town of *West Memphis, Ark.,* by FWA. The project will include a dredged channel, a pier, a hydraulic fill approach to the pier and to the river and railroads. . . . In the competition for a design for the State Veterans Service Building to be erected in connection with the Capitol approach at *St. Paul, Minn.,* the first prize of $5,000 went to W. Brooks Cavin, Jr., of Washington, D. C.

National construction research group

(*Continued from p. 37*)

retail lumber industry and the Producers' Council.

During the closing session, the council also passed a resolution calling for the complete and immediate removal of all remaining wartime regulations on construction, including rent controls on new housing, priorities, subsidies, and market guarantees. In floor discussion of the resolution, it was stressed that the council would continue to place emphasis on construction of housing for veterans but believed that the housing shortage can best be solved without government regulations, which were said to be a hindrance.

As a substitute for the present confusing program of the government agencies, James R. Edmunds, Jr., president of the American Institute of Architects, recommended that the government provide the industry with more worthwhile basic information, increase its activity to bring about better building codes, take steps towards better cooperation between industry and labor, and continue to aid in the advance planning of public works construction. A resolution incorporating this suggestion was later passed.

Sees $20 billion volume

Warren S. Bellows of the W. S. Bellows Construction Co., Houston, Tex., and president of the Associated General Contractors, forecast a construction volume of $20 billions next year if there are not too many interruptions from strikes and other causes, and if the industry becomes reasonably stable. The total would include about $6 billion for maintenance and repair, $3 to $4 billion for public works, and $10 to $11 billion for privately financed construction, about equally divided between housing and other types of construction.

The failure of the state highway department to go ahead this year with as large a road construction program as had been hoped for and the possible inability to carry out all the work for which money will be available next year was reported by M. J. Hoffman, commissioner of highways in Minnesota and president of the American Association of State Highway Officials. From Jan. 1 to Oct. 31 of this year, contracts were awarded for about $450,000,000 of highway construction involving federal funds, which is a program approximately at the prewar level, he said. Although this was considered a good start, he predicted that only about one-third of the available federal aid for the present fiscal year will be committed to approved projects and concluded that highway construction is running far behind the schedule planned when Congress passed the 1944 Federal-Aid Highway Act.

Commissioner Hoffman also went on to say, "Frankly, I see nothing on the horizon to indicate any early improvement.

Labor picture confused

Improvement next year in the delivery of building supplies was predicted by Thomas S. Holden, president of the F. W. Dodge Corp. He believes that most materials will progress from sellers' markets into buyers' markets during the course of the next year and material supply will cease to be the major bottleneck.

In contrast, Rich J. Gray, president of the building and construction trades department of the American Federation of Labor told the council that adequate labor is available at the present time and declared that next year it would be available in most types of work, although there might be some local shortages. He added encouragement when he said that much of the present inefficiency of labor on construction will disappear when all types of materials are available in adequate quantities.

Mr. Gray also predicted that there would be a reduction in work stoppages by labor disputes as conditions become more stable. But at the same time he pointed out that continued adjustment of wage rates in line with the purchasing value of the dollar will be required.

Building material supplies still short as price control on industry lifted

Engineering News-Record survey indicates slight improvements in supply when materials were decontrolled—Industry forecasts price rise, but sees greater supplies soon

Supplies of essential building materials—key factor in the nation's pressing housing and construction problems—were still woefully short when the federal government finally removed all pricing controls on the materials supply industry, an *Engineering News-Record* spot-check in twelve key cities indicated last week.

This check, the third in a series directed toward gaging the availability of supplies (see *ENR* June 27, vol. p. 963 and Aug. 1, vol. p. 131), confirms recent reports issued by various government agencies which were interpreted to show that although production is slowly increasing, it was—at least until the time controls were removed (*ENR* Nov. 14, vol. p. 627)—far behind foreseeable demand.

Brick in better supply

It is not possible to assess the effect of the removal of controls on prices, but the most recent survey should serve as a realistic basis for comparison after the supply industry has operated in a free market for a period.

Brightest spot revealed by the survey was the re-appearance of both common and face brick in most localities. In the August 1 survey, brick was not available. Concrete block—also very scarce in the earlier report—appeared in nearly adequate supply at the time controls came off. Reflecting the increasing brick and block supplies, too, were reports from *ENR's* correspondents indicating that black-market prices on brick had fallen very sharply. In New York City, for example, the under-the-counter price fell from about $45 per thousand brick (face) in August to about $21 by the first week of November. Cement again appeared available in adequate amounts.

Lumber situation confused

Lumber in general was in better supply, but plywood of all types was still very scarce and generally of poor quality.

Removal of controls on lumber prices seems to have thrown the entire supply industry into confusion on prices and as to probable supply. In Chicago, Boston, New York St. Louis and other cities, dealers refused to quote prices immediately, although many expected immediate rises in retail prices because of the tremendous demand for the product. Most suppliers, however, looked for an increase of supplies by spring.

The removal of price ceilings, however, had the immediate effect of ripping the bottom out of the black market, the reports said, with operators on this market beginning to dump their hoarded stocks as soon as news of the decontrol action became public.

An example of the effect of price-freedom was a report from the Maine lumber industry, where producers—who admitted that they had been operating at only 50 percent of capacity for the past two years—promised "normal" production as quickly as possible. Producers estimated that some 250,000,000 bd. ft. are now available for cut shipment in the state, and added that nearly half of this is seasoned wood.

As a whole, lumbermen seemed agreed that costs to the consumer would rise by about $10 per thousand board feet, but predicted the price would decline with increasing production.

Glass and steel scarce

Darkest spot in the supply picture appeared to be in plate and other forms of structural glass, and in structural and reinforcing steel.

In Cleveland, Boston, Chicago and other localities, builders stated that many projects being held up for lack of glass for windows, despite reports from major manufacturers of strenuous efforts being made to increase production. Steel production, hampered by shortages of scrap, was in most localities well behind.

Supplies of tile appeared to be increasing slowly, but were still well below demand.

Availability of labor continued to be a brighter spot in the picture, although, as in the previous surveys, it was apparent that labor is available principally because shortages in materials have held down the amount of work.

Midwest situation parallel

A special survey of the three midwestern states of Missouri, Kansas and Oklahoma, conducted to check area conditions against the specific city-by-city tabulation of the general survey, showed parallel conditions.

In the three states, brick—although still behind demand—was becoming more available, and producers and dealers hoped soon to be able to cope with current demand; lumber was in very short supply, and what was available was generally of inferior quality, and dealers using newspaper advertising urged builders to place orders as far ahead of need as possible; plate glass very short; and steel of all types far below demand. In these states, too, cement offered the only bright spot in the immediate supply picture.

In general, both contractors and suppliers looked hopefully toward the next few months in the belief that relief from price barriers would stimulate production, which in turn would bring down initially expected jumps in costs.

Factors adding to this belief include the removal of import controls on lumber and other materials that are expected to ease the domestic squeeze. No one apparently looks for any decrease in the demand for some time to come.

Commerce dept. reports shortages

Closely paralleling *Engineering News-Record's* independent survey of the availability of building materials, the Department of Commerce in its November report said key materials continued in very short supply, but offered hope that by early 1947 the situation will have eased.

The national picture in specific materials, according to the department, is:

Lumber—Despite large production increases in 1946, will not be in good supply for another year or two; Millwork—Industry unable to meet increasing demands; Hardwood Flooring—Production still far behind requirements; Softwood Plywood—Output increasing.

Clay products—Production of all clay products is at prewar levels. However, of three major clay products, brick was the only one that reflected an increase in stocks. Clay sewer pipe probably will be in good supply by the end of 1947.

Cast Iron Soil and Pressure Pipe—Supply is substantially below demand, unfilled orders representing more than 9 months' output. Heating equipment—Practically all types remain in short supply; Gypsum Board—Demand continues far ahead of supply, and supply not expected to be in balance before the middle of 1947.

Concrete block—Concrete pipe and cement were reported to be generally in good supply, as were asphalt roofing materials.

Arizona fights closed-shop contracts

Acting quickly to avail themselves of the protection of a new state constitutional amendment prohibiting "closed-shop" contracts, Arizona contractors and builders last week flatly told union officials that they would refuse to grant such contracts.

The anti closed-shop amendment was approved by state voters at the Nov. 5 election. Union leaders had demanded signing of new agreements for 1947 (present contracts expire Jan. 1) before the results of the Nov. 5 election are certified and the amendment prohibiting such contracts becomes law.

Meeting at Phoenix, members of the Arizona Branch, Associated General Contractors of America, and the Arizona Building Contractors Association passed separate resolutions empowering any committee representing the state's construction industry in labor negotiations to continue such negotiations "in good faith" but without entering any closed-shop agreements.

The amendment says in part that "no person shall be denied the opportunity to obtain or retain employment because of non-membership in a labor organization, nor shall the state or any subdivision thereof, or any corporation, individual or association of any kind enter into an agreement which excludes any person from employment because of non-membership in a labor organization."

Criticize labor attitude

Sharply criticizing the labor attitude, the AGC chapter resolution said that it had given notice Oct. 30 of its desire to amend the "union recognition" clauses of its present agreements, because of the anti-closed shop amendment which had then been introduced. "This notice," the resolution said, "was met by an unqualified demand that we forthwith sign a "closed shop" 1947 agreement, before the constitutional amendment approved by the people of Arizona on Nov. 5 becomes effective.

"There is much vital work to be done in 1947. . . . We want to see the building trades unions preserved, and reaffirm our faith in collective bargaining as the proper basis for negotiating wage scales and working rules.

"The closed shop is not an essential to such good relations, or to industrial peace."

Union leaders, both in Arizona and in national organizations, have already questioned the validity of the Arizona amendment, as well as similar amendments recently passed in Nebraska and South Dakota, and in effect in several other states. Officials of the Phoenix Building Trades Council said that they sought only to continue contracts which have been in effect since 1942.

The immediate union reaction, however, was to walk out of subsequent wage negotiations, leaders stating that, in view of the contractors' resolutions, there was "nothing more to discuss". There was no threat of a strike, however, although no statement was made as to possible action after the present contracts expire.

No collective bargaining for Seattle city workers

Denying a petition by Local B-77, Electrical Workers' Union, for recognition as a special bargaining agency for City Light employees' wages and working conditions, the Seattle, Wash., city council refused to establish a precedent of collective bargaining with city employee groups.

After pointing out that under the city charter all city employees are assigned to their civil service classifications by the civil service department, the council added:

"The fact that the assignments of certain employees have been to the City Light department and that within the last year clerical and other employees of that department have been enrolled as members of Local B-77 in no wise changes their status as civil service employees.

"As such, their salaries must, by law and of necessity, be the same as all other employees of the city in the respective civil service classifications to which they have been assigned.

"The council is without authority to deviate from this procedure or delegate any of its authority and responsibility to a joint wage conference."

Pittsburgh workers seek hike

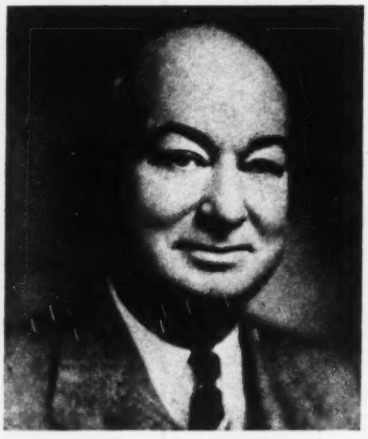
The Pittsburgh, Pa., city council, meanwhile, confessed itself unable to estimate the cost of the increases requested by city employees during recent annual hearings on the city's budget.

Representatives of almost every employees' group on the city payroll, some of them union leaders and some representing the police, firemen's and similar associations, asked jumps in present pay scales. Salaried employees, in general asked, an 18½ cent increase. Other employees asked raises up to $2.00 per day.

Construction trainees reach all-time high

The number of apprentices in the construction industry reached a new all-time high of 83,429 by the end of October, according to the Apprentice Training Service, Department of Labor.

The increased trend in October was shared in all of the basic building trades. The breakdown of apprentices listed in the various crafts at the end of October includes: woodworking, 32,328; electrical, 12,815; pipe trades, 11,650; trowel trades, 10,186.



***Engineering Firm Heads Change**—William T. Crawford (left) for the last ten years executive vice-president, has been named chairman of the board of Stone and Webster, Inc., Boston, Mass., engineering firm. Mr. Crawford succeeds Edwin S. Webster (right) co-founder of the firm, who is retiring after 57 years of direct association with the organization. Mr. Webster will continue his directorships in the company and its subsidiaries, and maintain an office in the organization's Boston headquarters.*

Army engineers get orders to start $41 million military building program

Most of work will provide added housing for troops at permanent establishments in United States—Non-housing work also approved

This week the Military Construction Division of the Office of the Chief of Engineers, was notified to proceed with about $41,000,000 of construction to provide additional housing at a long list of military bases within the United States. Approval of the work followed an order of a few days ago authorizing the Army engineers to proceed with more than $18,000,000 of military construction other than housing in the U. S.

The $18,000,000 non-housing program includes the following authorizations, by services:

Army Air Forces, $5,026,000; Ground Forces, $635,700; Corps of Engineers, $206,000; Chemical Corps, $731,800; Quartermaster Corps, $226,000; Military District of Washington, $41,000; Medical Corps, $660,000; Signal Corps, $175,000; Transportation Corps, $1,377,900, and Ordnance Department, $9,660,000.

The housing work will be carried out under the supervision of Brig. Gen. J. S. Bragdon, Director of Military Construction in the Office of the Chief of Engineers. The actual construction will be carried out by the district engineer offices, which plan to do the work by general contract.

Types of Housing

Two types of housing are planned. About $25,000,000 will be spent for the conversion of existing military housing into family-type quarters at a cost of $4,500 per unit. Over 5,000 units are to be provided.

An additional $16,000,000 will be spent for construction of about 2,000 new temporary family units. Because a present cost limit of $7,500 per unit has been placed on this work, the plan calls for construction of buildings providing four apartments each at the present time. Later, these 4-apartment units will be converted into 2-family or duplex houses.

In addition to the conversions and temporary family-type units, two bachelor officers' quarters are to be constructed.

The program calls for the engineers to provide housing at many establishments operated by the other branches of the war department. Two large projects are listed for the Military District of Washington, D. C.—about a $675,000 job at Arlington Farms, across the river from Washington, and $360,000 of construction at Fort Myer.

Additional housing is also planned at a long list of Army Air Forces bases. The largest of these jobs and the approximate amount to be spent at each are as follows: Elgin Field, Fla., $2,500,000; Muroc, Calif., $900,000; Andrews Field, Md., $1,575,000; Air University (including work at Maxwell, Craig, Gunter, Ala., and Tyndall, Fla. fields) $2,000,000; Castle Air Base, Calif., $900,000; Patterson, Ohio, $460,000; Las Vegas, Nev., $450,000; Rapid City, S. C., $324,000; Chanute, Ill., $400,000; Scott Field, Ill., $800,000, and the airfield at Smoky Hill, Kan., $360,000.

Large projects scheduled for the Army Ground Forces are: Fort Knox, Ky., $1,200,000; Fort Bragg, N. C., $1,530,000; Camp Carson, Colo., $1,100,000; Fort Leavenworth, Kan., $780,000; Fort Lewis, Wash., $1,890,000; Fort Riley, Kan., $770,000; Fort Jay, N. Y., $500,000; Fort Sam Houston, Tex., $1,302,000; Fort Meade, Md., $500,000.

Over $1,000,000 will be spent for additional housing for the signal corps. The greater amount of this money will be spent at the Fort Monmouth, N. J., cantonment, but some work is also planned for the Lexington, Ky., Depot, Sacramento, Calif., Decatur, Ill., and Iwo Rock Ranch, Petaluma, Calif.

About $1,400,000 of new housing will be provided at Transportation Corps stations.

New housing costing a total of about $1,800,000 is planned at five Corps of Engineer establishments. The largest of these projects will be $1,364,000 of work at Fort Belvoir, Va., and $225,000 at the Yuma, Ariz., test station.

For the Quartermaster Corps, nearly $2,000,000 of new housing is scheduled. Improvements are planned at eight locations in all, the largest calling for $1,000,000 of work at Camp Lee, Va. Only one Ordnance Department project is planned—over $340,000 of construction at the White Sands, N. M., research and development station.

Six projects are scheduled for the Medical Department. The largest of these will be $200,000 of work at the Beaumont General Hospital.

H. K. Bishop joins ARBA as division engineer

Hubert K. Bishop, a former deputy commissioner of the Public Roads Administration and well-known highway engineer, has joined the American Road Builders' Association as manager of the County Highway Officials Division and the Municipal Division, Charles M. Upham, engineer-director, has announced. Mr. Bishop succeeds Maj. John A. Long, who resigned last summer.

H. K. Bishop

The new ARBA official received his engineering degrees at Cornell and began his career as assistant city engineer in Hudson, N. Y. Later he was superintendent of public works for that city. He has held other important posts, such as superintendent of public works for the Territory of Hawaii; chief engineer, Indiana State Highway Commission, first deputy, New York State Highway Commission, and consulting engineer with several prominent engineering firms.

He will assist in the activities of the American Institute of Local Highway Administration.

H. L. Whittemore retires from Standard Bureau

Herbert L. Whittemore, well-known engineer at the National Bureau of Standards, retired Oct. 31 after 29 years of continuous government service. An authority on the testing of engineering materials, he has been chief of the engineering mechanics section since 1918.

In recent years Mr. Whittemore has carried on a program of testing components for prefabricated houses, studying possibilities for placing the mechanical design of small houses on a rational basis. His mechanical ingenuity in conducting these tests led to the development of equipment for checking the accuracy of tension and compression testing machines, for which the Franklin Institute presented him with the Longstreth Medal in 1938.

After receiving his engineering degree in 1903 from the University of Wisconsin, Mr. Whittemore held responsible positions with companies in this country, Germany and England. In 1917 he was called to the National Bureau of Standards to direct mechanical tests of war materiel a job he repeated again in World War II.

Mr. Whittemore's successor as chief of the engineering mechanics section is Walter Ramberg, who has directed the bureau's aeronautical research program since 1937.

Random Lines *from an editor's notebook . . .*

. . . In which the views and philosophy of an outstanding engineering educator are recorded in detail.

Thomas Radford Agg, dean of engineering and director of the Engineering Experiment Station, Iowa State College for 14 years prior to his retirement last July 1, has returned to his first love—engineering research.

In direct contrast to many engineers who divorce themselves completely from their profession upon retirement Dean Agg plans on increasing the tempo of his engineering activities. He will continue as a full-time member of the staff at Iowa State College, devoting his time and energies almost exclusively to research in highway economics. One of his extra-curricular projects, however, will be a modernization of his book *Construction of Roads and Pavements*, and the addition of a chapter on traffic engineering.

Affectionately called "T.R." by his many close associates and "Radford" by his more intimate friends, Dean Agg's reminiscences of undergraduate days and early engineering experiences are intermingled with an almost inaudible but hearty chuckle characteristic of one who has enjoyed his life's work to the utmost.

His ready wit and subtle humor are infectious. Yet he is ready at the drop of a hat to fight any issue which he considers adverse to the best interests of the engineering fraternity.

Dean Agg's biography illustrates a direct and steady approach to success and, as such, reflects well-earned credit to his alma mater. Born in Fairfield, Iowa, on May 17, 1878, he received his bachelor of science degree from Iowa State College in 1905, and his civil engineering degree in 1914.

Following graduation, he served three years as instructor in engineering drawing and theoretical mechanics at the University of Illinois, then he spent five years with the Illinois State Highway Department.

Joined college in 1913

In 1913 he joined the faculty of the department of civil engineering at Iowa State College, where he was for 17 years in charge of highway engineering instruction and research, except for two years spent with the armed services during World War I, which saw him rise from a captain to a lieutenant colonel in the Corps of Engineers.

In 1930 he was made assistant dean of engineering and two years later was appointed dean of engineering and director of the Engineering Experiment Station.

His most cherished honor is the George S. Bartlett Award received in 1936 from the Highway Research Board.

Despite the many demands of his teaching, Dean Agg has contributed much to engineering literature during the last three decades. An habitual early riser, most of his works have been prepared in rough draft between the early hours of 5:30 and 9 a.m.

T. R. Agg
. . . devotes himself to research

His best known work is *Construction of Roads and Pavements* originally published in 1916, the fifth revision of which was published in 1943. He also was co-author of three other outstanding books: *Engineering Valuation*, with Anson Marston; *Engineering Reports*, with the late W. L. Foster; and *Highway Administration and Finance*, with John E. Brindley. His research reports, published as Engineering Experiment Station bulletins, and other technical reports on engineering subjects would fill a small library.

In retrospect

In looking back over his long and colorful career, Dean Agg's one regret is that he did not have about two more years of "bumping the bumps" of highway construction in order to fit himself better for teaching.

The single accomplishment that gave him the greatest personal satisfaction was his long association as a member of the executive committee of the Highway Research Board of the National Research Council. In his opinion the Highway Research Board is doing an outstanding job in collecting much-needed technical information and distributing it to highway engineers in the field. He is quick to add, however, that his activities as a member of various boards and committees of the American Society of Civil Engineers have been an almost equal source of satisfaction. He served that society as director of District 16 from 1938 to 1940, and as vice president of Zone III (1942-43).

Fights unionization

One of Dean Agg's absorbing interests is collective bargaining for engineers. His first attack on the unscrupulous unionization of engineers was made in 1937 when he warned members of the Iowa Engineering Society of the many dangers that lay ahead. Since then, he has continued this fight at every opportunity, advocating the formation of a homogeneous bargaining agency.

Dean Agg is sincere in his belief, despite the fact that it might be considered heresy, that the engineer of today has attained his rightful prestige in our social and economic way of life. All that is required for him to retain his place in the sun is good hard work and a chance to be left alone to do his job.

Injustices and inequities are inevitable, he believes, if the engineer permits himself to be absorbed in the typical labor union. Should this happen, the engineer no longer will be able to pursue his activities properly, his hands will be tied, leading to his eventual loss of prestige.

Bright future ahead

Dean Agg is of the opinion that the "golden age" of civil engineering has not yet arrived, although he concedes that there has been a definite and readily noticeable trend during recent years toward a better training in fundamental sciences and in the so-called professional subject matter developed specifically along lines to expedite the solution of our everyday problems.

The outlook on the future of the licensing of engineers to practice their respective professions is "dubious," he thinks. He goes on to explain that too much emphasis is being placed by certain licensing boards on protecting the interests of the "homeboys." "Requirements of some state licensing laws that a candidate must have resided in that state for a certain length of time, and practiced engineering for a stipulated period before being eligible to obtain a professional license, is contrary to the spirit of engineering."

His chief hobby is the cultivation of hybrid tea roses, which he took up a few years ago when golf became too strenuous. In the wintertime his principal diversion is contract bridge, with Mrs. Agg for a partner, and based on "horse sense" method. . . . *J.R.C.*

Voters OK construction bond issues

At the recent November elections, in addition to voting for candidates for national and local offices, voters of many U. S. communities were called upon to decide on the issuance of bonds to finance civic improvements which ranged all the way from $20,000 fire stations to multi-million dollar water and sewage plants.

With some notable exceptions, most of the programs—all involving construction work—were approved, reports from *Engineering News-Record* correspondents throughout the country indicated.

Among the largest bond issues approved were: Two issues totalling $35,000,000 to finance a sewage disposal project serving the cities of Oakland, Berkeley, Alameda, Piedmont, Emeryville and Albany, Calif. (*ENR* Aug. 1, vol. p. 137), and other work; a $9,600,000 issue for water-supply and related improvements at Phoenix, Ariz.; a $660,000 issue to finance a municipal airport for Topeka, Kan.; a $750,000 issue for a new hospital for Riley County (Manhattan), Kan. and a $800,000 issue for a municipal auditorium at Manhattan; a $2,000,000 issue to finance improvements and additions to schools at Columbia, S. C.; $1,275,000 to finance a memorial coliseum at Fort Wayne, Ind.; $715,000 for various civic improvements at Guthrie, Okla.; $2,600,000 for civic improvements including new water and sewerage facilities and schools at De Kalb, Ga.

Major bond proposals turned down by voters included: A $1,500,000 issue for a proposed municipal stadium at Oakland, Calif.; a $1,500,000 issue for a new courthouse for Sangamon County (Springfield) Ill.; an $11,000,000 issue (*ENR* Oct. 31, vol. p. 569) that would have financed new schools, street improvements and water and sewerage improvements at St. Paul, Minn.; a $1,000,000 issue to finance a new municipal power plant at Sturgis, Mich.; and a $1,800,000 issue for repaving of county roads in McLean County, Ill.

Many issues approved

Among other approved issues, were:

Water and sewerage projects—Landsdale, Pa., $125,000; Pasco, Wash., $132,000; Vancouver, Wash., $600,000; Hiawatha, Kan., $200,000; and Guthrie, Okla., $450,000.

Schools — Fort Washington, Pa., $300,000; Louisville, Ill., $185,000; Ridgeway, Ohio, $125,000; Boardman Township, Ohio, $1,034,000; Austintown, Ohio, $500,000; Coffeyville, Kan., $250,000; East Peoria, Ill., $473,000; Central Bucks County, Pa., $800,000; Dalton, Ga., $110,000, and Olympia and Vancouver, Wash., $500,000 and $600,000 respectively.

Hospitals—Rolla, Mo., $400,000; Emporia, Kan., $250,000; Greenfield, Ind., $300,000; Defiance, Ohio, $500,000, and Louisville, Ill., $150,000.

Miscellaneous—Madera and Riverdale counties, Calif., $600,000 for sewer system expansion, additions to fire fighting equipment and swimming pool; Fulton, Mo., $200,000 for new municipal water and light plant; Hutchison County, Kan., $250,000 for county airport at Borger; and Ashland, Ky., $150,000 for a flood wall.

Four Alabama cities to finance gas pipeline

About $8,000,000 will be invested by four north Alabama cities in a 150-mi. natural gas transmission line and in distribution systems for Decatur, Athens, Hartselle and Sheffield. Construction work is to begin around Jan. 1.

J. W. Goodwin, president of the J. W. Goodwin Engineering Co. said that surveying parties are now at work.

The project will be owned by the four cities, but from the transmission line other cities of the Tennessee Valley will be able to obtain natural gas and will be on the same competitive basis as the rest of North Alabama.

It is expected the pipeline will be able to deliver 25,000,000 cu. ft. of natural gas daily to that area.

San Diego County joins Metropolitan Water Dist.

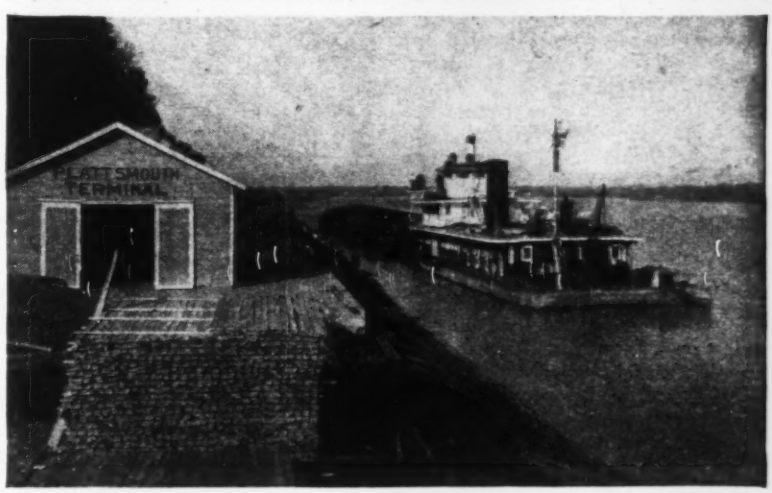
By a majority of more than 10-1, on Nov. 5 the voters of San Diego County elected to join the Metropolitan Water District of Los Angeles, an area including Los Angeles and 15 other cities and regions in Los Angeles and Orange counties. This action removes the last barrier in a long fight to make provision to increase San Diego's dwindling water supply.

The merger of San Diego County's Water Authority with the Metropolitan Water District will entitle San Diego to an immediate supply of 5 mgd. of Colorado River water, with an ultimate of 100 mgd.

The region will obtain the water through a pipe line that connects with the Colorado River aqueduct at the west portal of the San Jacinto tunnel and extends 71 miles to the San Vicente reservoir near San Diego.

Under the terms offered by the Metropolitan Water District, San Diego's membership will cost $13,000,000 in back taxes, to be paid over a 30-year period. In return the district will pay for and maintain the northern half of the aqueduct.

Excavation in the seven tunnels is more than 75 per cent complete, while the concrete lining of some of the shorter bores has commenced. Some 45 per cent of the aqueduct pipe has been laid. The first contract, which called for the building of a regulating reservoir with a 2½-mile pipe connection to the water district at the San Jacinto tunnel, has been completed.



***Army River Work Bears Fruit**—Army Engineers' steady work to improve navigation potentialities on the Missouri River bore fruit recently when the towboat "Franklin D. Roosevelt"—operated by the Federal Barge Lines—made its initial trip from Kansas City, Mo., to Omaha, Neb.*

California dam projects under study

Long standing controversies over three large California flood control and irrigation projects appeared to be approaching settlement last week, as state, Army and Bureau of Reclamation officials began consideration of the problems.

The state Water Resources Board ordered a state survey of the controversial Iron Canyon dam site on the Sacramento River below Red Bluff to decide whether a more expensive plan to substitute a number of smaller dams on tributaries of the Sacramento would be advisable. The Bureau of Reclamation now is studying a tributary plan, having gone on record against construction of either the $40,000,000 Iron Canyon Dam or one at Table Mountain, a third alternative.

It is charged that an Iron Canyon Dam would flood sections of the Anderson-Cottonwood district, disrupt Shasta County's road system and rob the tax rolls.

Opponents claim that the proposed dam is infeasible, pointing to the fact that charges have been made that geological formations at the dam site would make such a structure impractical; and satisfactory means of preserving the salmon run on the Sacramento River.

Hearing on Whittier Narrows Dam

Several years of controversy over proposed construction of a $12,000,000 Whittier Narrows Dam across San Gabriel River, south of El Monte, Calif., is expected to climax on Dec. 12, when a public hearing will be held in Los Angeles at the instigation of the U. S. Army district engineer.

Citizens and representatives of cities in the San Gabriel valley and other communities extending to Long Beach will attend the hearing to discuss whether the engineers should proceed with plans to construct a large reservoir behind the dam or redesign the San Gabriel channel to accommodate floodwaters. The Whittier Narrows issue has been before Congress for nearly a decade, with the cities of Rosemead and El Monte steadfastly opposing it.

Question Folsom size

Folsom Dam, huge multi-purpose project on the American River in California's Central Valley should store 1,000,000 acre-ft. of water, said Reclamation Commissioner Michael Straus after a recent inspection of the dam site.

In opening the question of Folsom Dam's size, Commissioner Straus became the first to offer public opposition to Gov. Earl Warren's recommendations to Congress earlier this year. Warren had said a 600,000-acre-ft. dam would be adequate. In so doing, he challenged the wisdom of both the U. S. Army Engineers and the bureau, who had agreed on the 1,000,000 figure.

Folsom Dam was authorized by Congress some years ago as a U. S. Engineers flood control project only. At that time, a 355,000-acre-ft. reservoir was considered large enough. However, before work could get under way and after the bureau had recommended the incorporation of power features for the structure, the engineers revised their surveys and also supported the 1,000,000-acre-ft. multi-purpose dam.

North Dakota amendment increases gas tax revenue

North Dakota voters on Nov. 5 by a majority of about 5 to 3 approved a gasoline tax law amendment which is expected to add some $1,500,000 a year to the income of the State Highway Department. The amendment constitutes a return to the refund system of gasoline tax collection, replacing the exemption system previously in effect. Because of easy evasion under the exemption system, North Dakota was collecting, on a percentage basis, less than half the tax accruing from gasoline sales to farmers in the neighboring state of South Dakota, which uses the refund system. The latter system requires the purchaser to pay the tax at the time of purchase and collect the rebate later by presenting required sales slips.

See rise for Army civil program limit

New increases in ceilings on the War Department's civil functions programs this week apparently assured the early continuation of all flood control projects now under construction, including those which involve important power installations.

The Budget Bureau announced that the Army Engineers have been authorized to spend an additional $55,000,000 for flood control work during the current fiscal year. This amount, plus other boosts allowed during October, permits flood control expenditures totaling $190,000,000 during the fiscal year—just double the $95,000,000 limitation recommended by the President last August.

At the same time the Budget Bureau authorized the expenditure of an additional $15,000,000 for the Engineers' rivers and harbors program. This was the first increase over the original ceiling of $90,000,000 set for rivers and harbors work.

No allocations of funds for specific projects accompanied the new authorizations, and the Engineers will select the works to which the funds will be applied. It is expected that the increase for flood control work will permit: (1) Continuation of all contracts already let for going projects; (2) awarding of some new contracts for projects on which preliminary work already had been started; (3) resumption of advance planning and preliminary surveys for certain projects.

Operations at the Clark Hill Reservoir on Georgia's Savannah River—plans for which now are being completed by the Engineers—are likely to get under way in the near future, Army sources indicated. The Engineers now expect to let contracts for all preliminary work and, perhaps, for construction of the dam itself in this fiscal year (*ENR* Nov. 14, vol. p. 630).

Other large power projects "frozen" under previous expenditure ceilings and now scheduled for early construction include the Bull Shoals Dam in Arkansas, Garrison Dam in North Dakota and Buggs Island Reservoir in Virginia.

War Department sources predict that the additional rivers and harbors funds will permit only the continuation of maintenance on existing projects, such as river silt control work and dredging. There is little prospect that construction on power projects like McNary Dam in Oregon and the Foster Creek project in Washington will be carried on under the present limitation.

MAJOR MEETINGS

Highway Research Board, 26th annual meeting, National Research Auditorium, Washington, D. C., Dec. 5-8.

National Society of Professional Engineers, annual meeting, Atlanta-Biltmore Hotel, Atlanta, Ga., Dec. 7.

American Association of State Highway Officials, annual meeting, Biltmore Hotel, Los Angeles, Calif., Dec. 17-20.

American Society of Civil Engineers, annual meeting, Commodore Hotel, New York, N. Y., Jan. 15-18.

Associated General Contractors, annual convention, Stevens Hotel, Chicago, Ill., Jan. 27-30.

National Crushed Stone Association, annual meeting, Edgewater Beach Hotel, Chicago, Ill., Jan. 27-29.

OBITUARY

W. A. Godshall, 50, Los Angeles, president of three southern California housing corporations, died Oct. 27. He headed the Overland Housing Corp., which built 640 homes in Los Angeles; the Mayfair Housing Corp., builder of several hundred dwellings in Long Beach, and the Harbor Heights Corp., which built a project in Wilmington.

Harry Cron Kennedy, 61, engineer, prominent in the hydro-electric field, died at Montreal Nov. 10.

Paul Wayne Riedesel, 52, formerly a resident engineer for the Minnesota highway department, and for the last eight years public health engineer with the Minnesota State Department of Health, died recently at his home in Wayzota. He had taken a prominent part in developing new methods of highway frost boil elimination. A 1916 graduate in civil engineering at Iowa State College, he received a degree in sanitary engineering from the University of Minnesota in 1938. In the first world war he served as a captain in the Corps of Engineers.

George Daniel Baldwin, 70, Erie, Pa., head of a building firm that was started in 1904, and which in the last 40 years built more than 7,000 houses in Erie, died Nov. 10. The firm was among the first to use mass-production methods in building.

Alfred E. Bounsall, 69, past president of the Wisconsin Road Builders' Association, died at Kenosha, Nov. 9.

Chester Hague, 71, who earned degrees in both civil engineering and architecture at the Massachusetts Institute of Technology and was an authority on the use of wood as an engineering material, died at Seattle, Wash., Nov. 4. He was active in the West Coast Lumberman's Association.

Victor T. Goggin, 58, wartime chief of Canada's Wartime Housing Limited, a civil engineer, and for many years senior partner in Goggin and Ripley, consultants of New York, died in Toronto on Nov. 17. A native of Winnipeg and a graduate engineer of the University of Toronto, Mr. Goggin spent 25 years in the United States, mainly in connection with building construction. Under his direction, War-time Housing Limited carried out an $80,000,000 program.

ENGINEERING SCHOOL NEWS

The civil engineering department of the University of Illinois is considering the carrying out of a project for the Illinois Division of Highways, studying drainage of depressed superhighways. The first application of such a project would be on the six miles to be depressed on the Congress Street superhighway in Chicago. Formal approval must be given by the board of trustees. Financing of the research project would be from the grant of one and one-half percent of the cost of federal aid highway money, which must be spent on research and planning.

The Carnegie Institute of Technology, Pittsburgh, Pa., has created a memorial book fund for the purchase of several thousand volumes to be added to the institute's library in memory of 123 men and one woman—alumni and former students—who gave their lives in the recent war.

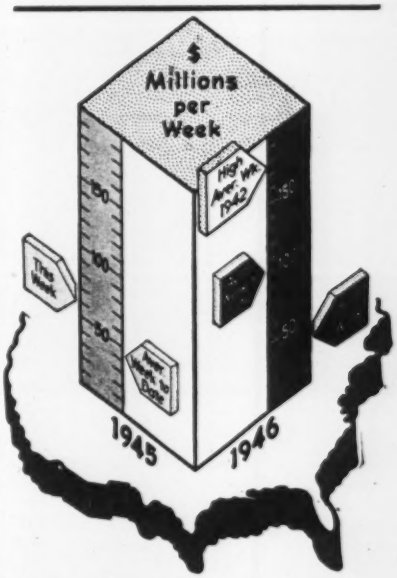
Richard King has resigned from the civil engineering staff of the University of Texas to become assistant professor of civil engineering at the University of Michigan, where he is teaching sanitary engineering. Professor King took his bachelor of science degree in civil engineering at the A. & M. College of Texas in 1938, and his master's degree at the Illinois Institute of Technology in 1940. His first position was as an instructor at the University of Connecticut, and from 1942 to 1945 he was a captain in the Sanitary Corps, U. S. Army, in the Pacific.

The new civil engineering building now under construction on the University of Washington campus, Seattle, will be called the Charles Church More building, the board of regents has decided. Professor More is one of the civil engineering department's best known instructors. He went to the university in 1900, and, except for brief periods of leave, has been on continuous duty. He is a consulting engineer on numerous Pacific Northwest projects.

N. H. Sheldon, former New York engineering consultant, and a graduate of Queens University, Kingston, Ont., has joined the faculty of the University of Miami, Fla., as research professor of engineering. One project on which he will work while teaching will be to determine what is the ideal house for a small family in southern Florida.

(*Continued on page 102*)

CONSTRUCTION ACTIVITY



As Reported this week to... *Engineering News-Record*

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of Nov. 28 1946	Cumulative 1946 (48 wks.)	Cumulative 1945 (48 wks.)
Federal	$4,167	$613,319	$729,323
State & Mun.	7,572	1,322,760	350,062
Total Public.	$11,739	$1,936,079	$1,079,385
Total Private.	20,835	2,911,364	972,014
U. S. Total...	**$32,574**	**$4,847,443**	**$2,051,399**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (48 wks.)	Cumulative 1945 (48 wks.)
Waterworks	$750	$101,481	$53,962
Sewerage	559	105,769	31,874
Bridges	1,711	122,589	40,007
Highways	4,112	725,581	206,475
Earthwork, Waterways	294	343,492	54,086
Buildings, Public.	4,226	388,134	448,483
Industrial	8,117	969,754	545,746
Commercial ...	12,174	1,758,174	312,401
Unclassified	631	332,469	358,365

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (48 wks.)	Cumulative 1945 (48 wks.)
NON-FEDERAL ...	$1,420,141	$703,939
Corporate Securities	461,190	185,811
State and Municipal	733,951	353,528
RFC Loans	.....	24,600
REA Loans	.....	60,000
Fed. Aid Highway	225,000	79,000
FEDERAL	1,672,982	1,049,398
Total Capital.....	**$3,093,123**	**$1,752,837**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	Nov. '46	362.47	174.24
Building Cost	Nov. '46	273.71	147.96
Volume	Oct. '46	233	102

EDITORIALS

VOLUME 137 NUMBER 22

November 28, 1946

Mixing Politics and Construction

THE BUREAU of the Budget last week answered in part a question that has been troubling many engineers when it reinstated part of the War Departments civil work program. Up until then it had been difficult to understand why the Bureau of Reclamation program had been restored to nearly its original scope while the Army Engineers were finding it necessary to reduce staff in order to keep within available funds. Now, funds for part of the flood-control program of the Army Engineers have been released, and possibly money for river and harbor work will come later. But even the release of these funds will not correct one of the major faults in the present program, namely, the insistence by Congress on allocating relatively small amounts of money to many projects instead of allocating ample funds to a smaller number. Of course, a little money to many projects means more satisfied constituents, but the end result is waste and uneconomic construction. For example, on some of the big jobs that have been resumed after being shut down during the war there is not enough money available to pay the contractor the amount he could earn between now and the end of the fiscal year by following the most efficient construction program using the equipment he has on the job. As a result, equipment is idle and current operations are limited to about what can be done with the money on hand. Meanwhile, overhead costs for both the government and the contractors go on, and there is a general slowdown among the men employed on the project who have no desire to work themselves out of a job. This is the result of mixing politics and construction; and in the long run, fewer projects can be built. Congress should give thought to this latter fact.

A Constructive Move

PRAISE IS DUE the Metal Trades Department of the AFL for the forthright stand it took at the recent convention in Chicago against jurisdictional strikes. It is particularly noteworthy that the action was not a mere resolution condemning such strikes, like those which have been passed before with no noticeable result, but rather the definite establishment of machinery within the union to effect a settlement of disputes short of strikes, as reported in the issue of Nov. 21. District and local trades councils were instructed to make the adopted jurisdictional agreement a supplement to existing bargaining contracts and to insert it in all new contracts. The chairman of the committee that proposed the no strike machinery is quoted as saying that jurisdictional strikes "are breaches of faith and a violation of contracts with employers. If contractual relations with employers are to endure we are compelled to make good our promises to the same extent that we insist upon the employer making good for us." Of such a blending of realism and reasonableness are constructive labor relations born. They will grow and flourish as contracts once made are recognized as inviolable, and as contract negotiations are carried out with more goodwill and less bludgeoning on both sides.

Dividends from Ingenuity

MANY INGENIOUS IDEAS were applied to construction of the concrete wharf at Richmond, Calif., described in this issue. All elements of the wharf were precast except the pile caps; but even for the latter the forms themselves were precast with the result that no wood forms had to be built out over the open water where such construction is slow and costly. Noteworthy also was the use of pipe guides for fitting the pile hammer over reinforcing rods projecting from the top of the piles and for threading rods projecting from the pile caps into anchor holes in the precast deck sections. In these days of rising construction costs, devices and methods that save time pay extra dividends.

Costs and Labor Productivity

EVIDENCE CONTINUES to multiply that construction costs have reached a point of diminishing returns, and that short of damaging deflation only increased labor productivity can bring costs down to a healthy level. Studies made by this journal early this year revealed that productivity was about 65 percent of that prevailing in 1939, based on a comparison of labor rates with actual costs of construction in place.

Some of the indicated reasons were beyond immediate help, but others could be removed by wise labor leadership. Thus the effects of short-

ages of labor, field delays because of material shortages and the inexperience of new workers can only be removed with the passage of time. Other effects resulting from union feather-bedding rules and union work quotas could, however, be eliminated immediately if labor willed it.

That the effects are real is evidenced in the case of an office building being built for a manufacturer in Ohio. Half finished, it was temporarily abandoned because it was costing $90 to put each 1,000 bricks in place. The bricklayers were limited to 450 bricks per 8 hours, and were seldom doing that well, although twice that number can readily be laid without excess effort. Here is an instance of labor pricing itself out of a job.

Another, also in the Middle West, resulted when a large company junked its plans to triple its capacity to produce rayon, badly needed for tires and other products, when costs proved too high. Studies indicated that the company needed to turn out three times as much product as before the war per dollar of plant investment to justify building at the present time. Still another building is reported to have been stopped when the use of concrete blocks, costing 22 cents each, required 26 cents apiece additional before they were in place.

It is not suggested that the efforts of labor alone can bring costs down the entire amount necessary, but much good could result, both actually and psychologically, by a changed labor attitude. Certainly an increase in labor productivity is the most direct means of cutting costs and thereby increasing building and jobs.

Engineers for the Railroads

A QUESTION of grave and growing importance to the railroads of this country relates to the small number of college-trained men seeking railroad work as a career. At the 1946 annual meeting of the American Railway Engineering Association, both the retiring president, A. A. Miller, and Henry T. Heald, president of Illinois Institute of Technology, stressed the seriousness of the situation and expressed opinions on what might be done about it. Mr. Heald placed responsibility squarely on railroad management for not seeking able young engineers and for not making railroad work more attractive as a continuing occupation. Like views were expressed in a recent report from the American Society for Engineering Education.

There are two basic causes for this condition—the end of railroad expansion, and banker domination of the railroads for many years past. The latter is the more serious, but now appears to be declining. Such domination loaded the railroads with fixed charges, which in turn greatly reduced the capacity of the railroads to make the necessary replacements and reconstruction that would have produced more work for engineers.

During the depression years of the 1930's all railroad engineering was of necessity reduced to or even below the point required to keep the properties going. As a result, the railroads seriously lack young engineering blood. In no place is it more obvious than in the A.R.E.A. itself. A hopeful sign is the fact that the association is conscious of the fact.

The picture may not be as discouraging as it appears on superficial examination, because we are inclined to estimate current needs on the basis of experience during the days of railroad expansion when almost every engineering school included railroad engineering in its curricula. Now that the day of active expansion is past, we do not know what the normal requirements of the railroad industry are. An actuarial study of how many engineers the railroads will need in the next decade for engineering and administrative positions would be helpful both to the railroads and to the engineering schools. The Association of American Railroads could profitably make a large contribution to such a study.

The fields of railroad maintenance and operation lack the glamour of railroad construction, but they still offer many opportunities for stimulating work that calls for a high order of engineering skill. And if the present prosperity of the railroads is to continue, then there should be more opportunities for engineers in the reconstruction and rehabilitation of railroad plant and equipment that is long overdue. But the best men to fill these positions will not be forthcoming unless the railroad companies seek them aggressively in the engineering schools, just as other large industries do, and unless they help the schools to visualize for their students the opportunities that engineering work in the railroad field offer.

ENGINEERING NEWS-RECORD
Copyright, 1946, by McGraw-Hill Publishing Company, Inc.
WALDO G. BOWMAN, *Editor*, EDWARD J. CLEARY, *Executive Editor*.
New York: V. T. BOUGHTON, R. K. TOMLIN, H. W. HUNT, E. E. HALMOS, JR., T. D. MacGREGOR, H. P. ORLAND and F. S. MERRITT
Chicago: V. B. SMITH, J. R. CARR, *Washington:* A. N. CARTER, *San Francisco:* N. A. BOWERS, L. L. WISE
EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK, N. Y.

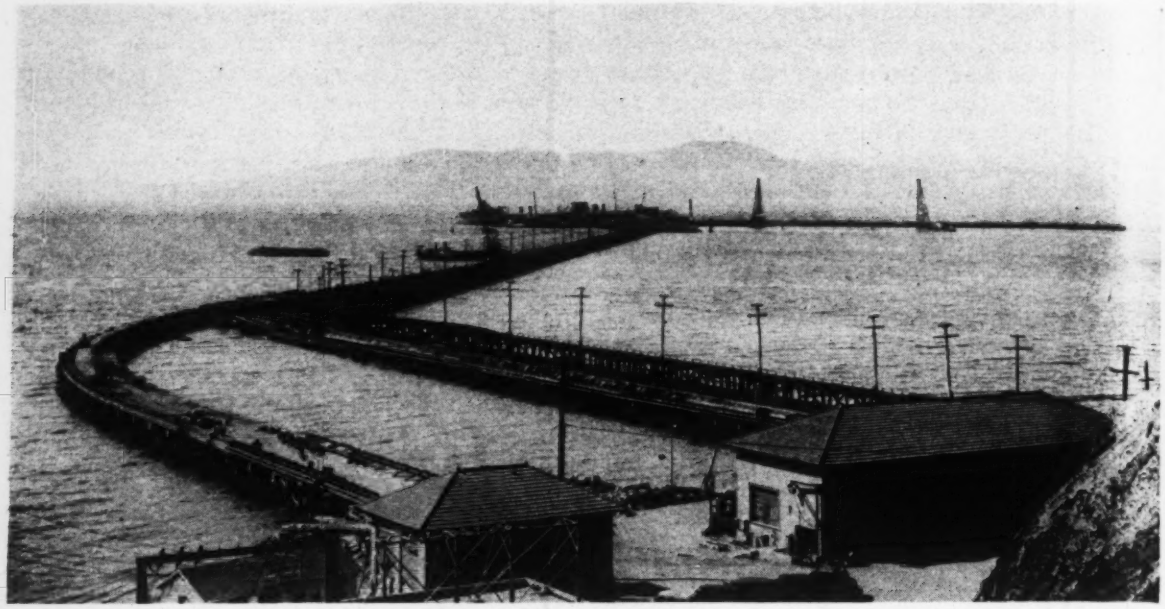


Fig. 1. The all-concrete causeway under construction at left, is to provide new means of access to the oil tanker wharf.

Causeway Built of Precast Units

***Contents in Brief**—Time, cost, labor and critical materials were saved on a causeway that employed precast piles and deck slabs as well as precast forms in which caps were cast in place. Casting of the precast forms for the pile caps in the casting yard was simplified by pouring alternate units in successive operations and omitting bottom forms.*

IN MAKING PLANS for a 4,000-ft. concrete causeway at Richmond, Calif., to expand and supplement the long wharf used by the Standard Oil Company of California for loading tankers, it was found expedient to precast all parts of the structure except the pile caps, and the latter were formed inside a precast shell. By thus doing away with the need for timber forming on the job, construction operations could be simplified, the work could be standardized and carried out by relatively small crews using heavy construction equipment and there would be minimum interference with existing facilities. The only concrete poured on the main structure was in caps on the pile bents.

The result of this well-systemized construction program was a "clean" job which progressed rapidly. Each stage of the work was done with its own equipment and all operations were so standardized that the crews became expert. The casting operations, likewise, were done to good advantage in a yard from which the completed units could be loaded onto barges for water delivery to the causeway.

A design using chiefly precast units was decided upon after studies had been made on creosoted timber, cast-in-place concrete and several combinations of construction materials. Although some skepticism was expressed at first about the plan for using precast cap forms, the idea as suggested by the contractor was finally adopted without reservation because the cap form constituted additional concrete outside the cross-section specified for the cap itself. There is provided in the monolithic concrete what is considered adequate coverage for the steel and the precast cap affords just that much more protection.

The contractor's casting yard, located in Petaluma some 17 miles by water route from the causeway, adjoins a ready-mix concrete plant and has access to Petaluma Creek, a navigable tributary of San Francisco Bay. For this job the yard was arranged in three divisions, one for piles, one for deck slabs and one for the forms in which the caps were to be cast.

Because of salt water exposure, original plans called for coating caps and the underside of deck slabs with hot asphalt. Also the piles were to be gunited, after driving, from cap down to El. +2. However, in view of tests made by Prof. H. A. Williams at Stanford University, it was decided to substitute in place of the proposed coating of completed unit, emulsified asphalt used as an admixture in the concrete.

Accordingly, and for the purpose of making the concrete easier to place as well as to make it more im-

pervious to moisture, a product called "Hydropel" was added in the proportion of 1½ gal. per sack of cement. Thus the admixture varied with the cement content, which was 7½ sacks of cement per cubic yard for piles, 6.3 sacks per cubic yard for deck slabs and 6.0 sacks per cubic yard for cap forms.

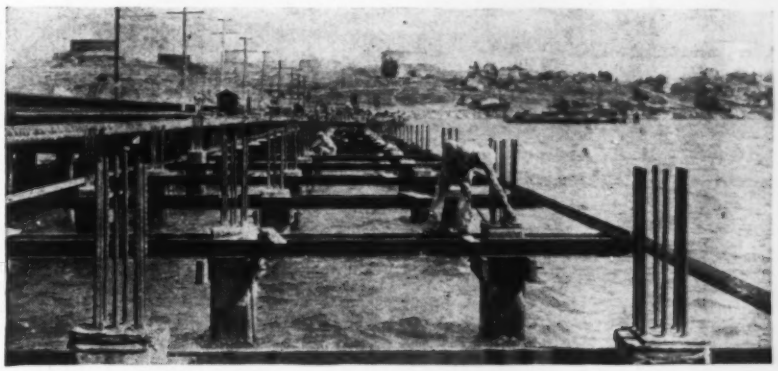
Data obtained in the comparative tests on plain concrete and concrete containing the admixture are summarized as follows:

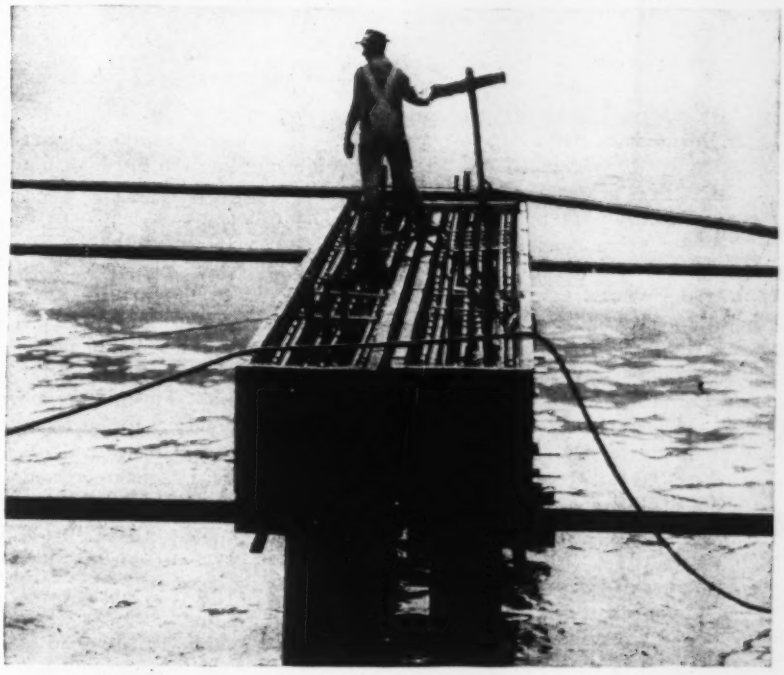
Carried on over a 3-year period, these tests made comparisons of plain concrete cylinders with others in which an admixture of 1½ gal. of the emulsified asphalt had been added per sack of cement. With a lower liquid-cement ratio (using for the liquid figure the amount of the mixing water plus the emulsion quantity) the slump in the treated mix was invariably greater than in the plain concrete, indicating improved workability despite the dryer mix. The absorption in the treated mix was only 15 to 25 percent of that in the plain concrete. The treated mix showed much the same average strength as the plain, the value being somewhat more at all ages (up to three years) for specimens cured in air and somewhat less (the difference being less than 10 percent) for specimens that were moist-cured for the entire test period.

Casting piles and deck slabs

Piles were cast with an 18-in. section; the majority were about 80 ft. long, though some 90-ft. lengths were used. The piles were cast in the usual manner in stacks four tiers high on a concrete foundation. Steel side forms only were required and were set up in pairs. The pile-casting area was spanned by a gantry from which was suspended a steel truss with tongs slung at intervals so that the piles could be lifted with a six-point pickup. At one end the gantry tracks straddled a mooring basin in Petaluma Creek, thus facilitating delivery of piles to barges. A second casting-yard gantry similarly handled units from the areas where floor slabs and cap forms were cast.

Provision for casting the 736 deck slabs was made by setting up 96 slab casting forms. The expectation was that each form would be used about eight times. All slabs were 20 ft.





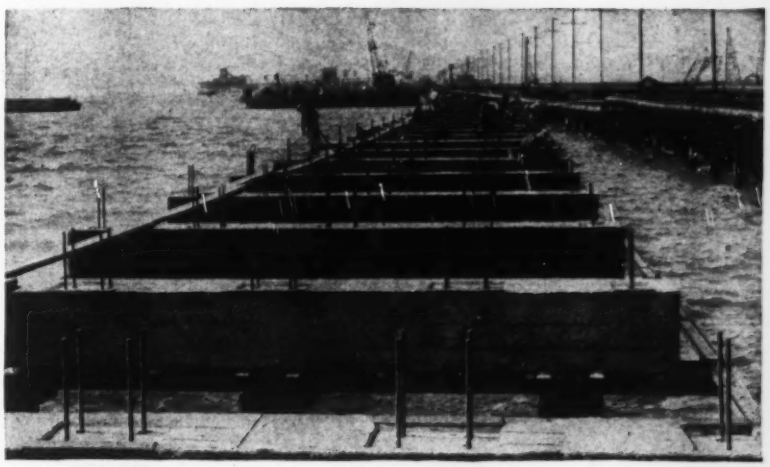


Fig. 2. Three stages in the construction are shown here. Transverse steel girts (top) are bolted to the tops of the concrete piles to form temporary supports for the precast cap forms (center). When the cap forms are filled, dowels are left projecting above them as anchors for the deck slabs.

long, the standard bent spacing. Seven different slab sizes were needed, though there were only two main types. These typical slabs weighed 15 tons each and followed the usual slab design with a 7-in. thickness in the central panel, beams 24 in. deep on the two sides and 20 in. deep on the ends.

The wood forms were covered with tar paper, stapled to the wood, before the steel reinforcing was placed. Loops of $\frac{7}{8}$-in. steel bars were left projecting above the surface of the slab near each of the four corners. After these had served their purpose for lifting and placing the slabs the bars were burned off flush. The slabs were figured for a H20-S16-44 loading (AASHO) and reinforcing steel was provided accordingly.

Precast cap forms

The cap forms were made in alternate pours using concrete of the first pour as forms for the second. The precast forms all had the same cross-section, a clear inside space 28 in. wide by 30 in. deep. They were designed with walls 3 in. thick and floor 2 in. thick reinforced with a grid of $\frac{3}{8}$-in. bars with half-inch bars at points of maximum stress.

For these precast cap forms the only wooden forms used were for side walls and ends. The side walls were braced in place with the lower edge 2 in. above the concrete base used as a pouring floor. Concrete was delivered from buggies into the side walls through a metal-lined rectangular chute with a flaring mouth or funnel made of a width to fit the delivery buggies. Bayonet-type vibrators in the side walls worked the concrete down until it had spread from each side half way across the floor so that concrete flowing in from the sides met near the middle of the floor. Finishers working inside the forms then smoothed off the bottom surface, as in a paving job, thus doing away with any need for bottom forms. In finishing this bottom surface a convenient tool was found to be a square-nosed shovel with the handle cut off about 14 in. from the blade.

Arrangements for setting caps

Each precast form had seven pairs of "hairpins" or loops of quarter-inch steel projecting into the inside of the form to be used for lifting and placing. The lifting was done 7 days after casting. Holes were left in the bottom of the form on a spacing to fit the spacing of the driven piles. These holes were made 24 in. square so that there would be some tolerance for exact placement in setting the cap on piles that might have been left slightly out of line in the driving process. Each cap form contains about 2 cu. yd. of concrete and weighs about four tons. Reinforcing steel in the cap proper went to the job already in place in the cap forms, thus simplifying construction.

After a barge-load of piles was delivered to the causeway a six-point pickup was used to lift the piles into position in the driver leads. When the pile was suspended in the leads and before resting the hammer upon it, an ingenious device, dubbed "the milking machine," was used to save time as the loftsman threaded the eight steel bars projecting from the pile top into corresponding holes in the hammer.

This consisted of eight 2-ft. lengths of pipe that could be slipped through the holes in the hammer but which were prevented from passing all the way through by transverse bolts across the pipe tops. As the hammer was held suspended at just the right height above the pile in the leads, the loftsman raised each pipe slightly and threaded it over one of the projecting bars. When all eight were thus fitted, lowering the hammer automatically guided the bars into the proper holes.

Steel girts support cap forms

After the piles had been driven the next operation was the placement of temporary steel channel girts both longitudinally and transversely across the bents, in preparation for assembling the deck structure. The transverse girts were set by instrument at just the right level to support the precast cap forms and were given superelevation on curves.

In placing the longitudinal girts, the location of each pile was checked and if necessary the pile top was moved an inch or two, with the aid of a rachet-operated chain block, to maintain the 20-ft. bent spacing. Because of remarkable uniformity in driving, few piles were out of line more than a few inches. Piles were moved only in a direction parallel to the length of the causeway. Slight misalignment in a transverse direction was not considered important. Before tightening up the bolts used to clamp girts to piles, a short piece of 1-in. board was found to serve a useful purpose in increasing friction between steel of the girt and concrete of the pile.

Precast cap forms were placed by a derrick barge which also filled the forms with concrete from a mixing plant carried for this purpose. This barge loaded up at a nearby plant on shore with enough sand, gravel and cement for pouring about ten of the concrete caps. After completing this number of caps, the barge again

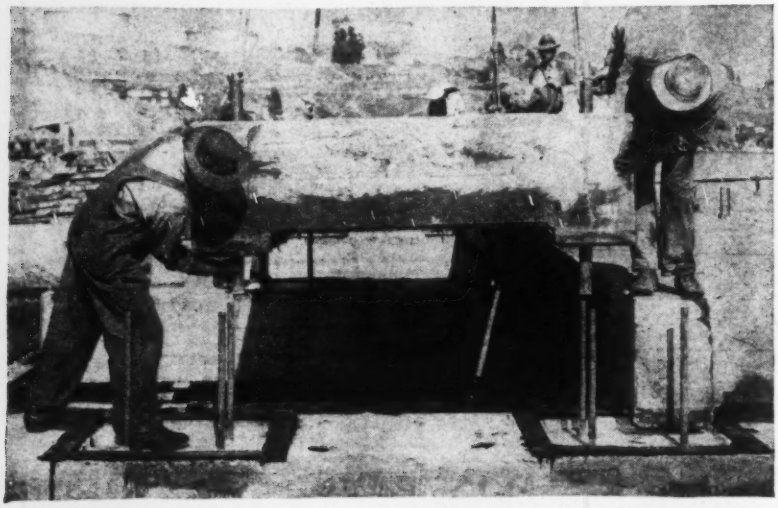


Fig. 3. Speedy lowering of the deck slabs is facilitated by removable pipes which are slipped through holes in the slab to act as guides for the dowels.

returned to shore for more material.

A derrick on the concreting barge lifted the cap forms from a delivery barge with the aid of a steel beam used as a strong-back equipped with seven pairs of lifting hooks much like those used at the casting plant. When each cap form was lowered to place it was rested on 1-in. boards placed atop the transverse steel girts bolted to the piles. As the form was lowered the top of the piles and the steel projecting upward were passed through the openings left in the bottom of the forms for this purpose.

After the form was resting on the girts, the next operation was to bend down the vertical bars projecting from the piles to place them in the form where the concrete would bond the steel of the piles with that already in the cap form. To prevent leakage of concrete around the edges of the 24-in. hole in the bottom of the form through which the 18-in. square pile projected, a wooden collar was first threaded over the top of the pile and rested on top of the steel girts. As the thickness of boards in this collar was the same as that of transverse boards laid across the girts for the form to rest upon, all supports for the precast form were at grade over the full length of the girt. On the rare occasions where slight transverse misalignment occurred in pile positions the holes in the cap form bottoms were correspondingly enlarged.

The last steel to be placed in the cap forms were the 1¼ x 36-in. dowels embedded 12 in. in the cap and projecting above just enough to extend almost through the deck slab. These dowels were accurately placed with the aid of a transit and were held in position, during concrete pouring, by a wood bracket or frame rested on top of the cap form but held firmly in place by wires to the reinforcing steel below. After concrete in the caps had set these wood brackets were removed and the projecting steel was left to be threaded into the deck slabs as they were placed.

Placing the deck slabs

Precast deck slabs were delivered on barges which were moored alongside the derrick barge used to place them in the deck. Preparation for landing a slab on a cap involved only the laying of ¾ x 4-in. strips of asphalt-impregnated fibre board around the anchor bolts that projected upward from the caps. As these anchor bolts had been set by instrument and holes in the slab also were accurately located at the time of casting, no instrument was needed for lining up as slabs were lowered to place.

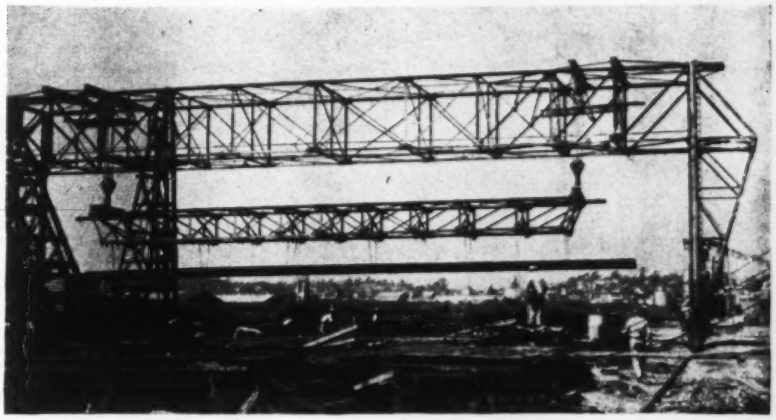


Fig. 4. Gantry spanning a casting yard bay takes two 90-ft. piles to the barge on which they will be towed to the causeway.

To facilitate threading these projecting bolts through the 3-in. vertical holes left in the slab for this purpose, short lengths of pipe were thrust into the holes in the slab, from the top, as the slab was lowered toward exact position in the deck. Horizontal bolts through the tops of these pipes prevented their dropping entirely through the deck slab. The pipes were long enough to project from the underside of the slab and hence could be easily and quickly placed over the projecting steel as the slab was lowered. Thus the steel was automatically guided into the slab holes and the pipes were then removed for reuse.

The final operation in deck slab placement was the pouring of grout in the holes around the steel bars from the cap. The asphalt-felt strips around the projecting steel, pressed firmly in place by the weight of the deck slab, served as a retainer or gasket to prevent escape of grout while the space around the steel in the deck slab holes was being filled.

Perhaps the best evidence of the advantage and economy in careful advance planning and the simplification of the actual work of assembling the causeway units appears in the rate of progress. Once the crews were broken in and the operations were standardized, the deck slabs were picked up from delivery barge, lowered accurately to position and left ready for grouting at the average rate of eight per hour or 64 per 8-hour day.

Precise level of the surface in adjacent deck slabs was not of critical importance because plans called for completion of the roadway by placing a 3-in. asphaltic wearing surface on the causeway deck. Deck slabs on the outer edges of the 24-ft. roadway (26 ft. overall) had a 14-in. curb which was cast around dowels left projecting to provide a bond. The curb will be surmounted by a timber guard rail of the type ordinarily used on highways.

The causeway is part of a $4,370,000 modernization program to improve the oil shipping facilities of Standard Oil Company of California's Richmond refinery. The work is being done under the general direction of R. W. Parker, chief engineer of the manufacturing engineering division, and, A. W. Gleason, refinery management representative. Design and supervision of construction is by Austin W. Earl, San Francisco, assisted by J. G. Wright. Milton H. Watt is resident representative of the Earl organization on the causeway. Swinnerton and Walberg Co. and Ben C. Gerwick, Inc., as joint venturers are the contractors for the construction. Alfred Cantor, general superintendent for Ben C. Gerwick, Inc. is project manager for the joint venture. The Gerwick organization owns and operates the casting yard at Petaluma.

Aluminum Span for E-60 Railroad Bridge

***Contents in Brief**—What probably is the first all-aluminum span to carry railroad traffic has been installed as a deck plate girder in a bridge that has similar steel spans for comparison. Plates and shapes are high strength 14 S-T alloy, while rivets, driven cold, are A17 S-T. The aluminum span about 100 ft. in length, weighs 53,000 lb. and was set in one piece by an erection derrick that could handle only one of the two girders of the comparable steel span that weighed 128,000 lb.*

TWO ALL-ALUMINUM deck-plate girders have been installed to form one of the 100-ft. spans in a seven-span railroad bridge over the Grasse River near Massena, N. Y. Three of the steel spans are identical in length and design requirements, thus providing a basis for comparison between the steel and aluminum spans in heavy railroad service. The bridge is part of a 2.5 mile relocation of the Massena Terminal R. R., which serves the Massena Plant of the Aluminum Company of America.

Illustrative of the difference in the metals, and a major advantage of aluminum, is the fact that the 30-ton erection derrick that set the completely shop-assembled aluminum span could set only a single girder of the comparable steel spans. After each of the steel girders had been set singly, the cross frames and diagonals had to be placed and riveted by crews working over the river on swinging scaffolds. The aluminum girder span, complete except for rocker shoes, ties and rails, weighs 53,000 lb. as compared with 128,000 lb. for the steel span.

The bridge is designed for Cooper's E-60 loading. Fundamental design data are given in Table II.

TABLE I—TYPICAL PROPERTIES—ALUMINUM ALLOY 14S-T

Tensile yield strength (at a set of 2 percent)	58,000 psi.
Tensile ultimate strength	68,000 psi.
Elongation in 2 in. specimen	13 percent
Shear yield strength	36,000 psi.
Shear ultimate strength	42,000 psi.
Fatigue endurance limit	18,000 psi.
Weight per cu. in.	0.101 lb.
Coefficient of expansion 1 deg. F	0.0000125

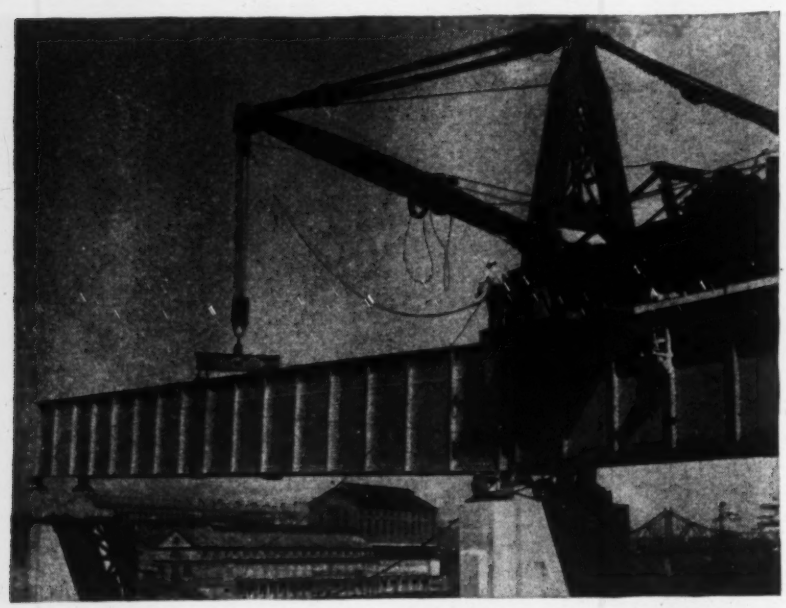


Fig. 1. First major aluminum bridge span frames the hydro-installation that supplies power to the Massena plant of the Aluminum Company of America.

Structural 14 S-T aluminum alloy was used for the bridge members as that type of alloy has taken the place of the earlier 27 S-T alloy. It can be produced with greater uniformity, has somewhat higher strength and is easier to work. For design of this span, however, the manual *Design Specifications for Bridges and Structures of Aluminum Alloy 27 S-T* by Leon S. Moisseiff was used, resulting in a slightly higher factor of safety than the 2.50 in tension used in the manual. (For general information on structural aluminum see How and When to Use Aluminum Alloys, by R. L. Moore, *ENR* Oct. 18, 1945, vol. p. 518.)

All plate material is of the protected type in which a thin coating of pure aluminum is rolled integrally with the high-strength alloy to increase its resistance to corrosion. Angles, tees and fillers are of all 14 S-T alloy. The 120-in. deep, $\frac{3}{4}$ in. thick web plates are in four lengths and required three splices. The 8x6x$\frac{5}{8}$ in. flange angles and the tee sections in the cross-frames and diagonal bracing were extruded rather than rolled since this was more economical for the small tonnage required, but other members, including the plates, were rolled. Cover plates are 14x$\frac{5}{8}$ in. Two top cover plates extend the full length of the girder to give uniform bearing for ties and to increase the strength over web and flange splices. One bottom cover plate is full length and the other is on the center 61 ft. of the span.

A comparison of members of the aluminum and steel spans is made in Table II. Major differences will be noted throughout, the principal one being in the 120x$\frac{3}{4}$-in. aluminum web plate, as compared to 108x$\frac{1}{2}$ in. for steel. To stiffen the deep aluminum web, a horizontal 5x3$\frac{1}{2}$x$\frac{3}{8}$-in. angle is used between vertical stiffeners on the inside of each of the two girders, about 30 in. below the top of the web. Rivet spacing is somewhat

TABLE II—DESIGN DATA—ALUMINUM AND STEEL PLATE GIRDER SPANS

Allowable Unit Stresses for Aluminum.

(Steel design follows American Railway Engineering Association 1943 Specifications)

Axial tension, net section	21,000 psi
Tension in extreme fibers of rolled shapes, girders and built-up sections, subject to bending.	21,000 psi.
Shear in plate-girder webs, gross section	12,500 psi.
Shear in cold-driven rivets alloy A17S-T	10,000 psi.
Shear in hot-driven rivets alloy 53S-W	8,000 psi.
Bearing on power-driven rivets; milled stiffeners and aluminum parts in contact	30,000 psi.

Aluminum—97 ft. 6 in. c.c.

Design loads		Shear—kips	Moment—ft.-kips
Dead load		27.5	669
Live load (Cooper E-60)		220.3	4,628
Impact 55.5% of L.L.		122.3	2,569
		370.1	7,866
	A	I (gross)	I (net)
Web. 120 x 3/4	90.00	108,000	80,774
4—8 x 6 x 5/8	33.44	111,664	87,408
4 Pl. 14 x 5/8	35.00	129,702	111,177
Total	158.44	349,366	279,359
Section modulus available			4,542
Section modulus required			4,495

End stiffener	4– 5 x 3½ x 3/4 angles
Int. stiffener	2– 5 x 3½ x 7/16 angles
Horiz. stiffener	1– 5 x 3½ x 3/8 angle
Top laterals	1– 8 x 6 at 11.6 tee
Bot. laterals	1– 6 x 4 at 3.96 tee
Cross frames	tees

Steel—98 ft. c.c. supports

		Shear—kips	Moment—ft. kips
		48.0	1,178
		221.2	4,660
		120.1	2,585
		389.3	8,423
	A	I (gross)	I (net)
Web 108 x 1/2	54.00	52,488	39,534
4—8 x 8 x 3/4	45.76	123,871	100,321
4 Pl. 18 x 5/8	45.00	135,529	120,470
2 Pl. 18 x 9/16	20.25	63,000	56,000
Total	165.01	374,888	316,325
Section modulus available			5,642
Section modulus required			5,615

	4– 6 x 3/4 angles
	2– 6 x 4 x 3/8 angles
	None
	2– 5 x 3½ x 7/16 angles
	1– 5 x 5 x 3/8 angle
	angles

closer in aluminum than in steel as the rivets have a lower shearing strength. Flange angles and cover plates on the steel spans, however, are substantially larger than for aluminum.

Much greater deflection is expected from aluminum than from steel due to the modulus of elasticity ratio of about 1 to 3. Some of this difference is counteracted by the greater depth of the aluminum girder. The camber diagram calls for $1\frac{5}{16}$ in. at the quarter points and $1\frac{1}{4}$ in. at the center of the aluminum span. This is equivalent to the deflection caused by the dead load plus one-half of the design live load, a departure from steel design practice where only dead-load deflection is allowed for, in this case $\frac{1}{4}$ in. Total deflection under full live load is expected to be a little over 2 in. compared to $\frac{3}{4}$ in. for the steel span of similar length.

Expansion of aluminum is about twice that of steel. For the 100 ft. span a 13½-in. high rocker is used, designed so that the span can move 2 in. either way from plumb. The rocker was set to be plumb at 100 deg. F. This was accomplished by moving it out of plumb $\frac{1}{8}$ in. for each $8\frac{1}{2}$ deg. the temperature differed from 100 deg. when the rocker was set.

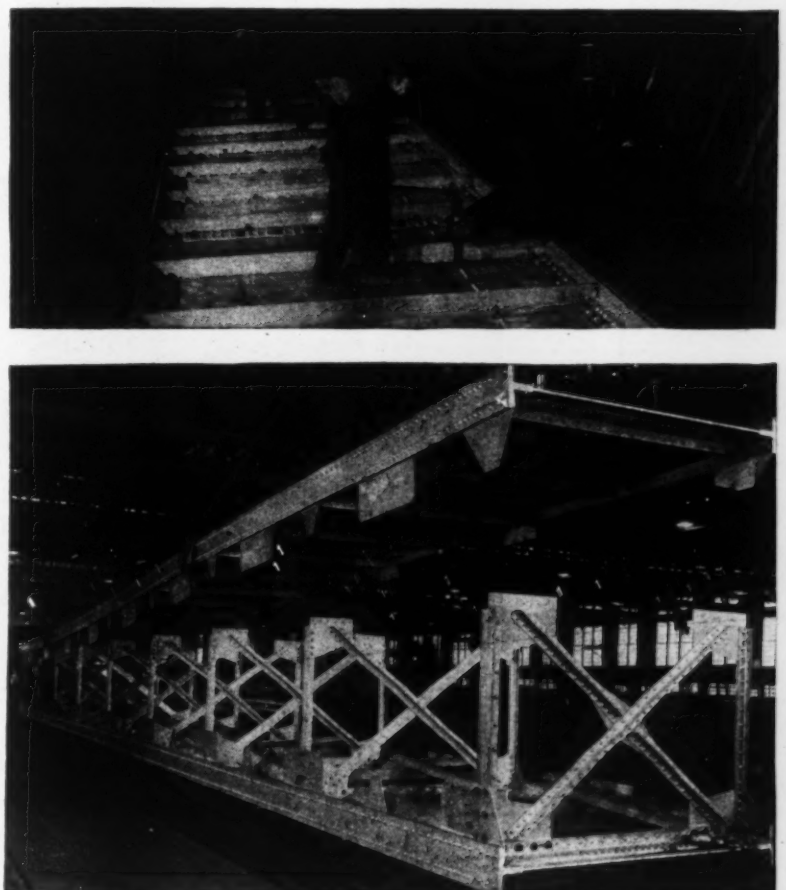
Complete shop assembly possible

Due to the light weight of the aluminum, which made possible handling the entire span in one piece for erection, the bridge unit was assembled completely in the fabricating shop. It was shipped ready to set on the piers, thus eliminating entirely any assembly or riveting in the field.

Shop fabrication and assembly of aluminum was very similar to that for the steel spans. Filler plates were used back of vertical stiffener angles, contrasting with the crimping that was done with the steel angles. Holes in aluminum plates or shapes thicker than ½ in. were drilled, while thinner aluminum and all of the steel was punched.

Immediately prior to assembly, all metal-to-metal contact surfaces on the aluminum span were covered with aluminum-pigmented caulking-compound paint and the excess was wiped off as it squeezed out during the fitting and driving. After assembly, and just prior to driving, holes for $\frac{7}{8}$-in. cold driven rivets were reamed to 57/64 in. and those for hot rivets to 29/32 in.

With the exception of 116 rivets where the cross frames tie to the girders, all of the rivets were driven cold by an air ram. Rivets to be



Bethlehem Steel Co. photos.

Fig. 2. Pneumatic ram forms aluminum rivets cold as assembly of span is done completely in the Rankin shop of Bethlehem Steel Company.

Fig. 3. Part of a tire casing under the hook when lifting the 53,000 lb. span is the only concession erectors made to aluminum. Note splice of 120x¾-in. plate.

Fig. 4. Manufactured and driven rivet heads in the end cross-frame.

used cold were made of A17 S-T aluminum alloy, impact extruded, with a high button head. Used only where the air-ram could not be worked, hot-driven rivets were made of 53 S-W alloy and were driven by pneumatic hammers at about 1,030 deg. F., the heat treating temperature of the metal. Driven heads on both hot and cold rivets are the cone-point type, Fig. 4.

The aluminum truss was painted with a prime coat of zinc chromate and two coats of aluminum paint before shipment to the site. One 6-ft. wide panel, between vertical stiffeners, is to be left permanently unpainted to observe the long-time effect of weathering on the unprotected aluminum components. Steel spans of the bridge were painted with one coat of red lead and two coats of aluminum paint after being assembled in place in the structure.

No price comparisons are available on the aluminum and steel spans but the Aluminum Company does not claim that such spans can be built more economically of light metal. This installation is an experiment in use of aluminum for major structures. It is believed that it will prove the practicability of such applications and lead to use of aluminum for lift spans and in other cases where light weight and resistance to corrosion are important.

The aluminum girder is one of four nominal 100-ft. spans, which, with a 90-ft. and two 75-ft. spans, make up the new Grasse River crossing of the Massena Terminal R.R. Concrete piers, up to 50 ft. high and founded on the rock bed of the usually shallow stream, carry the spans.

In addition to the Grasse River, the 2.5-mile relocation crosses the Raquette River on three 100-ft. and three shorter plate girder spans. Besides the two river crossings, the railroad has four highway grade separation structures and crosses the intake canal from the St. Lawrence River to the hydro-electric power station at the Aluminum Company plant. The old railroad line, with 2½ percent grades and up to 17-deg. curves, had structures that could carry only Cooper's E-37 loading. The new line will carry Cooper's E-60 loading on a maximum of ½ percent grade with one compensated 10-deg. curve. The total cost of the 2.5-mile improvement is about $900,000.

Fig. 5. Erection derrick that set complete 100 ft. span of aluminum could handle only one of the two girders that make up the similar steel span.

The relocation is being built by the Massena Terminal Railroad Co., for whom C. E. Smith & Co., of St. Louis, prepared the general plans including design of the steel spans.

The aluminum span was designed by the General Engineering Department of the Aluminum Company at Pittsburgh with assistance from the Development Division and Aluminum Research Laboratories. Hardesty & Hanover of New York City were consultants on the aluminum bridge span.

General contractor for the relocation is Harrison Construction Co. of Pittsburgh. Aluminum plates, shapes and rivets were supplied by the Aluminum Company. Fabrication of the aluminum span and all of the steel spans was done by Bethlehem Steel Co. at their works at Rankin, Pa., and erection in the field was handled by the same firm.

Preventive Maintenance Extends Life Of Missouri Highway Equipment

***Contents in Brief**—Increased efficiency and prolonged use of maintenance equipment of the Missouri State Highway Department is ascribed to preventive maintenance and on-the-spot repairs. Meticulous records of upkeep costs pay dividends in more economical operation of equipment.*

PREVENTIVE maintenance has paid big dividends in reducing the cost of repair and operation and in prolonging the life of the Missouri State Highway Department's vast inventory of maintenance equipment and personnel-transportation vehicles. Some idea of the magnitude of the job can be gained from the amount of equipment involved. It includes 665 trucks, 344 motor graders, 237 tractors, 93 pull-type graders, 241 pickups, 177 passenger cars and 289 miscellaneous pieces of equipment, including power shovels, rollers, air compressors, concrete mixers, asphalt distributors, etc. With this equipment, some 16,000 miles of state highways are maintained in first-class condition.

All state-owned equipment is purchased and owned by the equipment division and assigned to the other divisions of the department, as needed, on a mileage or hourly rental basis. In addition to carefully kept cost records on each piece of equipment, the equipment division has perfected a check-up system of preventive maintenance that is one of the chief factors in the efficient and economical operation of the equipment.

Systematic field inspection

For this check-up system there are four general inspectors, located at the department's general headquarters in Jefferson City, Mo., who travel continually throughout the state making systematic inspection of the department's equipment and reporting both current and impending break-downs direct to the superintendent of equipment at Jefferson City. In addition, each of the state highway department's ten division offices employ three traveling mechanics, each equipped with a pickup truck and sufficient small tools to make a variety of on-the-spot repairs to the maintenance equipment.

These field mechanics must be thoroughly competent men, capable of making repairs on all makes of trucks and automobiles and on even the heaviest types of tractors and other power equipment owned by the department. Although they usually have had an extensive background of experience in commercial garages, they undergo an intensive training period of from six months to one year in the division garages before being assigned to the job of traveling mechanic.

Customary equipment of the traveling mechanic includes a ½-in. electric drill with a 100-ft. extension cord, which often permits him to tap some nearby source of electric power; welding equipment; about a "bushel" of nuts, bolts and washers; and a various assortment of small tools.

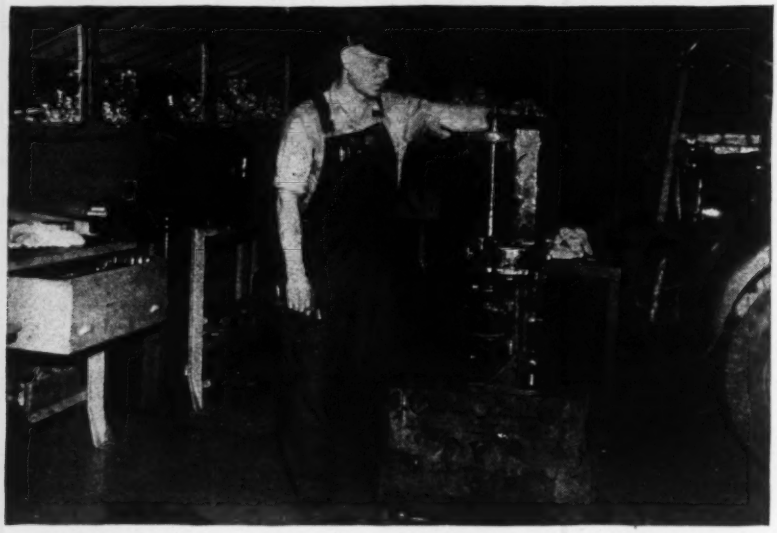
In addition to the traveling mechanics, each division headquarters employs a garage foreman and from three to five skilled mechanics to make such repairs to the equipment as are too large to handle on the job. This work is performed in a fully-equipped repair garage under the supervision of a division garage foreman at each of the ten division headquarters.

Many break-downs avoided

The close and continual cooperation among the general equipment inspectors, the traveling mechanics and the division garage mechanics does much to avoid costly break-downs of the equipment on the job.

The garage for Division 5, which is located in Jefferson City, is much more completely equipped than any of the other nine division garages. It maintains an inventory of about $400,000 worth of repair parts and equipment supplies. The other garages each keep only about $25,000 worth of parts in stock, and requisition additional parts from the main

Traveling mechanics prevent costly breakdowns of maintenance equipment by making many repairs on the job.



Typical activities in the division garages include the motor overhaul and repairs being made at the St. Joseph headquarters (above) and reboring motor block for a 1½-ton truck at the Springfield, Mo., division headquarters (below).

headquarters garage in anticipation of their needs.

All passenger cars are overhauled and repaired in the garage of the division headquarters to which they are assigned. Most major repairs of the maintenance equipment such as repairing tracks on crawler-type tractors and replacing pistons in large motors also are made in the division garages. But the real large repair jobs such as reboring large motor blocks, straightening frames of large tractors and motor graders, and complete overhauling of motor graders and tractors are done in the garage at Jefferson City.

All body work as well as vulcanizing and retreading of tires ordinarily is done in commercial garages, principally because these repairs are scattered so widely throughout the state as to make it uneconomical to make them with state equipment and labor.

Operates as "fleet owner"

The equipment division of the state highway department acts as "fleet owner" of the state-owned equipment. It operates on funds supplied by the maintenance division and bases its rental rates so as to break even each year, charging for gasoline, oil, grease and tires, depreciation of equipment, actual cost of repair labor and overhead, and the cost of repair parts plus ten percent. Any adjustment necessary in operating funds is made with the maintenance division at the end of each fiscal year.

The maintenance division of the highway department uses 83⅓ percent of the state-owned equipment. The remainder is assigned to the construction and bridge departments, field surveys, and to personnel transportation.

No figures are available on the rental rates established for the 2,046 pieces of state-owned equipment but the operation costs of motor equipment for last year, exclusive of insurance, license fees, interest on investment and taxes, are as shown in the accompanying table.

Each unit owned by the equipment division is treated as a separate entity, with meticulous records being kept on cost of operation and upkeep in order to determine its length of economical operation.

Supplying the pneumatic tires re-

TABLE OF OPERATION COSTS OF MAINTENANCE EQUIPMENT

(Exclusive of insurance, license fees, interest on investment and taxes)

Equipment	Unit of cost	Minimum	Maximum	Average
Passenger car	per mile	$0.016	$0.045	$0.018
Pickup trucks	" "	0.016	0.022	0.019
Trucks	" "	0.017	0.150	0.038
Tractors	" hour	0.200	3.241	0.643
Motor graders	" "	0.417	5.284	0.794
Pull-type graders	" "	Zero	1.375	0.166
Air Compressors	" "	0.163	1.384	0.545
Asphalt kettle trailer	" "	0.268	0.492	0.411
Asphalt distributor	" "	0.235	0.923	0.461
Roller	" "	0.268	2.863	0.832
Power shovel	" "	1.039	1.613	1.274
Scraper	" "	0.560	1.362	1.050
Road disc	" "	0.104	0.898	0.458
Concrete mixer	" "	0.527	0.694	0.571
Mud-jacking machine	" "	0.570	1.015	0.994
Mower	" "	0.355	0.398	0.376
Loader	" "	0.073	1.119	0.187

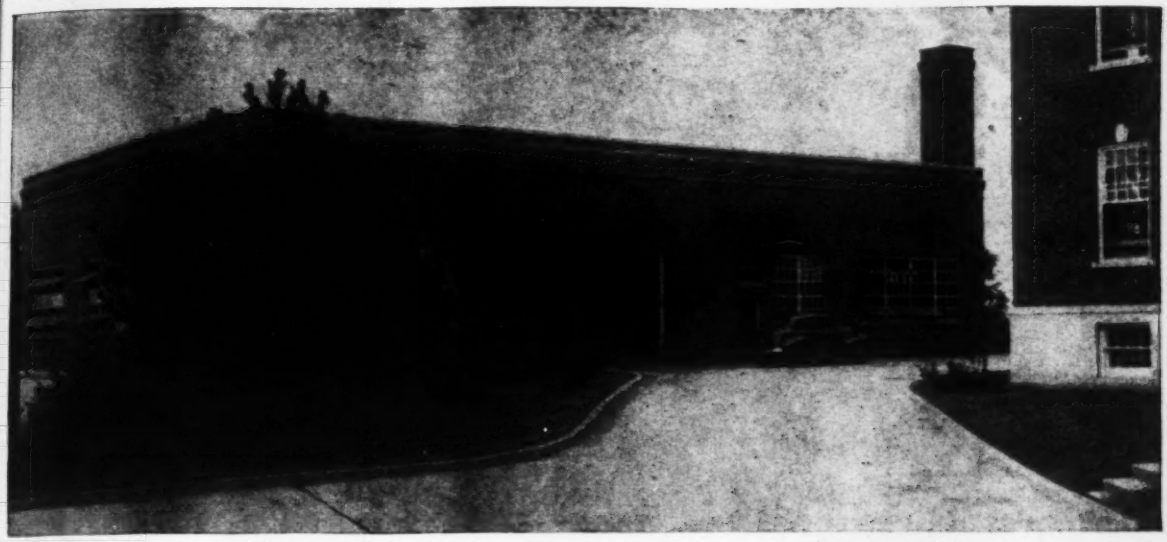


Fig. 2. Each division headquarters has a two-story garage fully equipped to make all but the largest repairs on the state's highway maintenance equipment.

quired for the state's maintenance equipment is big business, itself. All tires are purchased direct from the manufacturer and stocked in the main warehouse at Jefferson City. They are supplied to the division headquarters as needed, but each requisition must show for what unit of equipment the tire is needed, and the old tire, together with its card record, must be sent to the general headquarters where it is given final inspection and sold as scrap rubber if no longer usable. While this method involves some transportation expense it guards against possible loss or misplacement of a tire and insures getting the last economically usable mile out of the tire.

Inventory 65 percent of normal

The current inventory of the Missouri State Highway Department's maintenance equipment is not more than 65 percent of what is needed, according to R. P. Cummins, superintendent of equipment, who sees little hope in correcting this deficiency until the end of next year. At present the most urgently needed types of equipment are motor graders and trucks of 1½ and 2-ton capacity. The department has had virtually no success in purchasing government-owned surplus equipment for highway maintenance work.

Diatomite Filters Offer Advantages In Industrial Applications

Diatomite filters such as used in army and navy mobile water purification units offer advantages for industrial uses of savings in space and weight and more effective filtration, E. G. Kominek of Infilco, Inc., Chicago, told the American Chemical Society at its recent meeting.

The army and navy mobile units "weighed between 5 percent and 18 percent of sand filters of corresponding capacities, and demonstrated ability to removed amoebic cysts and blood fluke larvae as well as suspended matter without requiring any special technique by the operator. These benefits are equally important in industrial and municipal filtration application, although in such cases the higher operating costs of diatomite filters should receive consideration," Mr. Kominek said in a report to the society's Division of Water, Sewage and Sanitation.

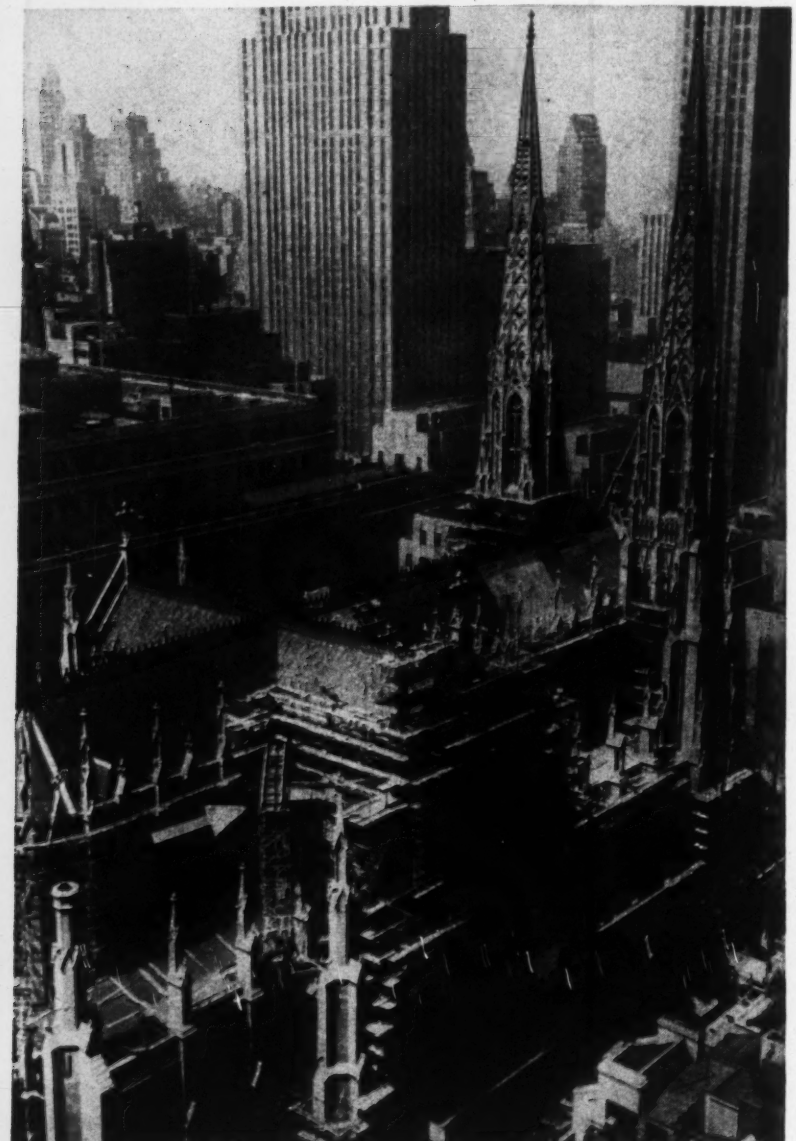
While operating costs are higher than in sand filters, the considerable saving in floor space of diatomite filters is important in many industrial plants so crowded for space that conventional filters could not be installed without expensive changes in plant layout, he pointed out.

Diatomite filters provide a positive means for removing organisms which cannot be controlled with chlorine or removed completely in sand filters. In addition to amoebic cysts, *chironomus* or blood-worm larvae are completely removed. Adsorption of oil from condensate, and the reduction of tastes and odors from water are other applications where diatomite filters can be used to advantage.

Fine filtration has been obtained at rates as high as 8 gal. per min. per sq. ft., although in many applications a lower rate must be used. However, in the case of many industrial applications investigated the diatomite filter proved to be superior to other filtration methods. Diatomite filters warrant the consideration of chemical and sanitary engineers for most filtration problems, according to Mr. Kominek. Although it is not anticipated that they will replace sand filters for most water purification applications, because of the higher operating cost, there are many cases where their use is indicated because of their smaller space requirements and lower installed cost, and because of the finer filtration obtainable.

Timber Trusses of Cathedral Roof Supported by Outside Cantilever Beams

For a few weeks recently the crossing at the intersection of the nave and transept of St. Patrick's Cathedral on Fifth Ave. in New York City, was hung from temporary counterweighted cantilever beams while the deteriorated ends of the permanent timber trusses were repaired and reinforced. The unusual use of this suspension rigging was part of a general renovation job being done on the frame and stonework of this great Gothic structure built in the years 1858 to 1879.



Falsework encases historic St. Patrick's Cathedral on Fifth Ave. in New York for general repair and renovation of the stone. The load on the roof trusses at the intersection of the nave and transept was picked up by four 50-ft. cantilever beams (one is shown by arrow) while repairs were made to the ends of the timber trusses supporting the roof.

The roof at the crossing of the nave and transept is supported by six timber trusses (two on the diagonal, and one on each of the four sides) of which three converge at each corner. The masonry corbel that supported the ends of the trusses was found to be badly deteriorated, the old lime mortar having completely crumbled away in many of the joints. In addition, the truss timbers, especially near their juncture at the support point, had rotted away so that in some cases only 50 percent of the original section remained effective.

No interference with use

Without interfering with the occupancy of the cathedral, which is in daily and almost continuous use, it was necessary to pick up and support the roof section while the masonry beneath the capstones was cut out and replaced, and while structural-steel reinforcing was framed and tightened about the weakened ends of the timber trusses.

Temporary support for the truss ends was provided by erecting a fulcrum of H-sections and angle braces on the outside wall of the cathedral and installing, at each corner of the intersection of the nave and transept, a pair of 51½-ft. long cantilever beams with the necessary pick-up hangers and angles at the ends of the trusses. The outer end of the lever was held down by loading it with a weight consisting of water-filled standard 5x7x5-ft. Navy steel pontoons—surplus from pontoons built for the Seabees in the war. The lever system was tightened and maintained during the work to just such a degree as would permit a piece of paper to be slid beneath the bearing points of the timber trusses.

The counterweight of the support

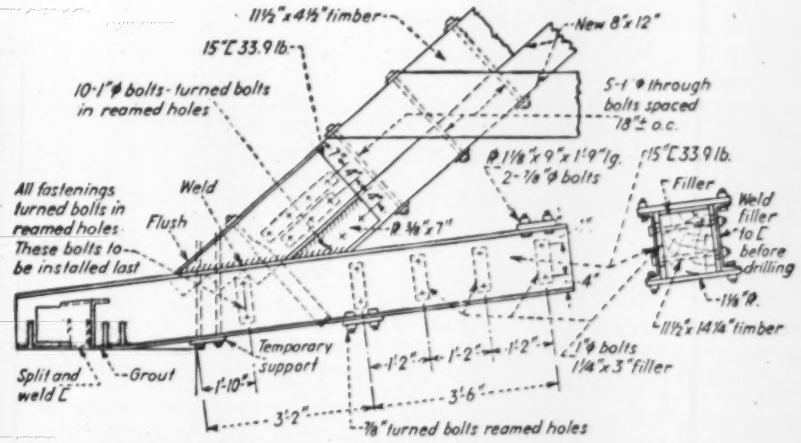
Typical of the rotted conditions found when routine repairs required opening up the roof over the truss ends. Steel hanger rods are part of emergency support.

system was accurately adjusted to balance the weight and then was just allowed to come to rest on a low frame. Such a suspension system prevented movement of the crossing with respect to the rest of the structure resulting from temperature changes and other structural movement. Details are shown in the sketch at lower right.

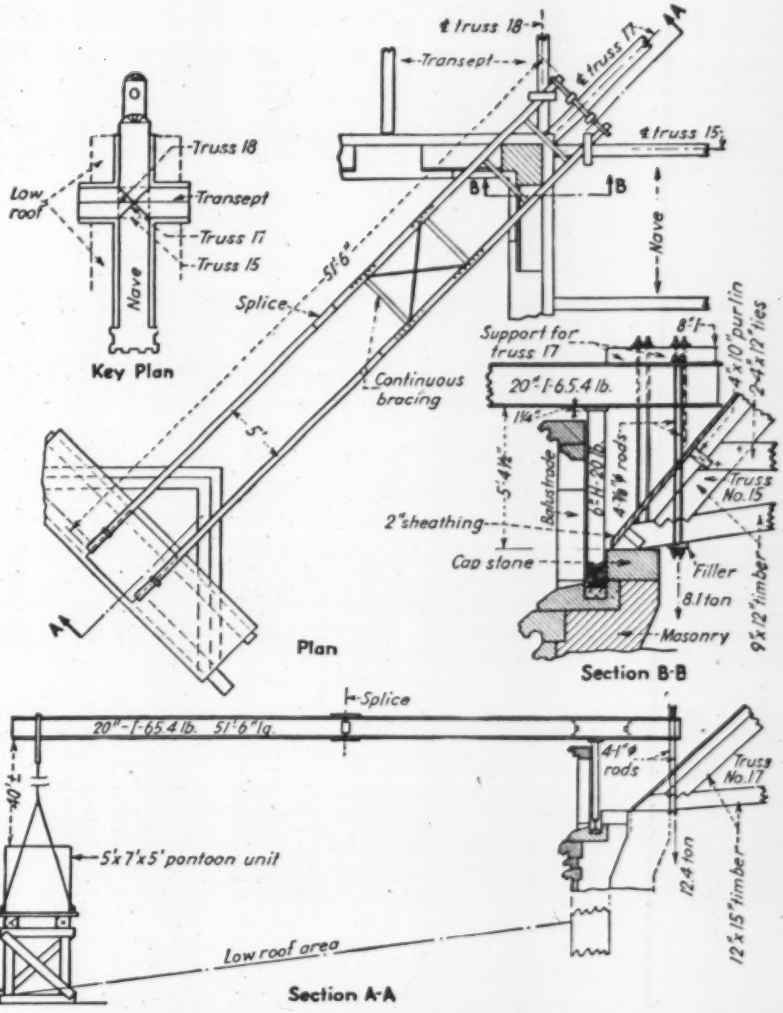
Framed to prevent movement

An accurately-framed structural steel encasement was used to supplement the rotted end timbers of the old truss. The steel was connected to the timbers by accurately drilling holes in the wood slightly smaller than the bolts for a driving fit through reamed holes in the steel. Steel-to-steel connections were made with turned bolts in holes reamed after final assembly. Welding could not be used in the assembly because of the fire hazard in the dry wood of the cathedral roof.

The roof repairs, as well as the general renovation work, are being carried out by the George A. Fuller Co. for the trustees of St. Patrick's Cathedral. Consulting engineers on the structural features of the roof were Moran, Proctor, Freeman & Mueser of New York City.



Permanent repair of the trusses was effected by putting a structural steel frame at the rotted ends. Details are shown for Truss 17, other trusses are similar.



Details of support device used at each of the four corners of the intersection of nave and transept for repairs to St. Patrick's Cathedral in New York City. The war surplus pontoon unit was loaded to just balance the trusses and then the temporary hanger rods were tightened until a piece of paper would just slide between the timber and the old masonry corbel.

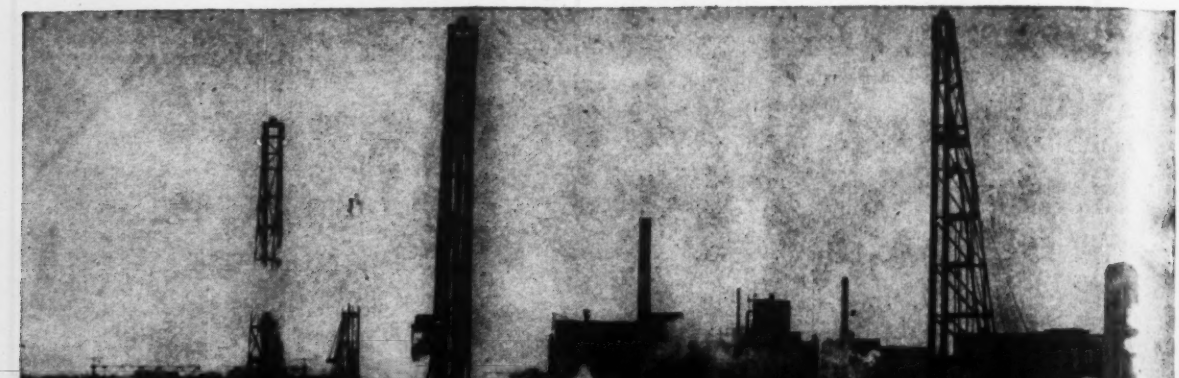


Fig. 1. Heavy loads of a large printing house in Chicago are to be carried on step-tapered piles driven by four rigs.

Driving 3,850 Piles for 60-Ton Loads

***Contents in Brief**—To support a new concrete building for Lakeside Press in Chicago, the contractor was required to drive step-tapered pipe piles for a design load of 60 tons each. These piles consisted of a heavy steel pipe resting on rock or in hard-pan with a corrugated upper section, driven closed-end in intimate contact with the soil and then filled with concrete. Part of first floor is supported on saturated, compacted sand. Only two of the ultimate five stories of the building are being erected now.*

STEP-TAPERED pipe piles driven to rock, or to refusal in hardpan, just above the rock, and filled with concrete solved the problem of adequate support for the R. R. Donnelley & Sons Company's new block-square printing building now under construction in Chicago. Each pile was designed to carry 60 tons.

The new building will be located on the east side of South Parkway between 23rd and 24th St. paralleling the Illinois Central R.R. It is designed for five stories, two of which are being constructed at this time, with the other three to be added later.

The construction, in general, is reinforced concrete, two-way flat slab construction with columns spaced 25 ft. in both directions. Press room floors will be covered with creosoted wood block. The ventilating fan rooms and penthouses to be installed above the second story under the present program are of steel construction to facilitate their removal when the future stories are added.

Heavy design loads

Some idea of the necessity for the 60-ton bearing loads on the foundation piles can be gained from the heavy floor loads used in the structural design. They are: 1,000 and 2,000 lb. per sq. ft. on the first floor, 350 lb. on the second and third floors, and 250 lb. per sq. ft. on the balcony, fourth and fifth floors. Where the first floor rests directly on the ground no support is provided by the piling. Instead, the heavy loads are transmitted through the floor to a thoroughly compacted layer of saturated sand.

Preliminary borings disclosed that the site, which formerly was occupied by an old brewery, consists of 7 to 12 ft. of cinder and brickbat fill, followed by about 20 ft. of fine sand and silt. Below this extends a bed of clay overlying hardpan or rock at about elevation —55 to —68. This clay offered inadequate support for the heavy superimposed loads of the printing house, resulting in the use of the step-tapered pipe piles.

Owing to obstructions on the site, about 4½ ft. of surface material was first removed down to elevation +12. All piling was driven from elevation +12, following which the basements were excavated. After the basement walls had been constructed, the areas between basements were filled in to provide support for the first floor, which is generally at elevation +18.

A contract for driving the 3,850 piles required to support the block-square building was awarded on Jan. 7, 1946, to the Raymond Concrete Pile Co., which first made full-size tests on piles loaded to double the required capacity. The last pile

was driven on May 25. Placing of reinforced concrete pile caps was started immediately by the Peter Hamlin Construction Co., Chicago, general contractor for the project.

Four crawler-type, piledriving rigs, moving parallel from south to north, were used to carry on the work, operating in two 8-hr. shifts daily. Three of the rigs operated 6,500-lb. rams having a 36-in. fall. The other used a 7,500-lb. ram with a 42-in. fall. An average of 55 piles, ranging in length from 64 to 82 ft., were driven each day.

In structural makeup, the piling consisted of a bottom section of steel pipe 40 to 45 ft. long, 10.75-in. O.D., 5/16 in. thick walls and closed at the bottom with a ¾-in. welded plate. Above this length of smooth-surface pile were added 8-ft. lengths of corrugated sheet steel shells of various gages, each section being progressively increased 1 in. in diameter. The piles were grouped in clusters of 2 to 20 to correspond with the spacing of columns above and the loads to be carried.

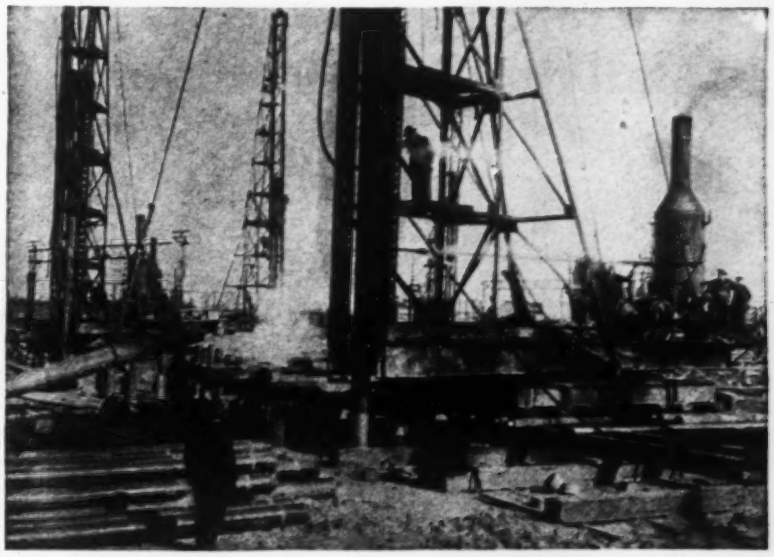


Fig. 2. The composite pile consists of 40 ft. of 10.75-in. O.D. steel pipe for the bottom section, with an equal length of corrugated metal shell added in 8-ft. sections, each section progressively increasing 1 in. in diameter. After being driven to rock, or refusal in hardpan, the piles were filled with concrete.

Waterproof joints in piling

Joints between lengths of corrugated shells were made by screwing a corrugated collar on the bottom of each section into the top of the next lower section after the joint had been coated with a waterproofing compound. After the full needed length of corrugated shells had thus been made up, it was lowered over the previously driven smooth pipe section. At that point, however, a 14-in. skirt of sheet steel attached to the lower section of corrugated shell was slipped down over the top of the smooth pipe to make a similar waterproof joint.

Immediately following the driving and retapping of each cluster of piles, they were filled to cut-off level with concrete. Later, the metal casings were cut off at the required elevation with a specially constructed internal cutter that was handled and rotated by a system of cables attached to a crawler-type crane. The hoisting cable on the crane raised and lowered the assembly while another cable from a drum on the crane rotated the cutter by means of a bull-wheel attached to the top of a shaft extending up from the cutter.

The first floor will be used chiefly for storage of large rolls of paper, with ample provisions for receiving and shipping paper and finished products. Two railroad spurs will enter on the south side and extend the full length of the building, with lift bridges being provided for access across the tracks. Docks for trucking will be located on the west and south sides of the building.

A north basement, included in the present contract, will provide for the installation of public utilities, and there will be a central basement for baling used paper and for storage.

Printing and binding and accessory equipment, with necessary offices and employees' rooms will occupy the second floor, which is to be 25 ft. high. Men's lockers, toilets and showers will be installed on a mezzanine at the north and between the first and second floors. Space also will be provided on the second floor for conference rooms and first-aid facilities.

The future third, fourth and fifth floors also will be used for presses and binderies with adequate locker, toilet and shower facilities. Six freight and passenger elevators are to be installed, two hydraulic and four electric. Separate stairways also will be provided for men and women, and adequate fire escapes.

Ventilation ducts for the two stories now under construction will be installed with access through the third floor (present roof), and provisions are being made for future brick ventilating stacks to take care of added stories. Waste paper and dust will be handled by a battery of ten circular chutes from roof to basement, and a cyclone chute.

In architectural treatment, the exterior of the new building will conform closely to that of the company's present printing building, situated one block to the north. Exterior finish will be face brick, with terra cotta and stone trimmings and cast aluminum spandrels. Alternating in checkerboard fashion in the spandrels, colored terra cotta shields representing the various insignia of the printing arts will be inserted.

Engineering personnel

Albert Kahn Associated Architects and Engineers, Detroit, Mich., are the architects and engineers on the work, and their field representative is John W. Taylor. E. G. Walker is building superintendent and H. P. Zimmerman is president of R. R. Donnelley & Sons Co. H. E. Lindholm was construction superintendent for the Raymond Concrete Pile Co., and L. J. Wysockey is superintendent of construction for the Peter Hamlin Construction Co.

Solving the Problem of "Nalyeds" In Permafrost Regions

A. Tchekotillo
Acting Director, The V. A. Obruchev Permafrost Institute, Academy of Sciences of the U. S. S. R.

***Translator's Note**—Construction of roads and buildings in regions of frozen ground presents special difficulties, some of which were encountered on the Alaska Highway. Russian engineers have long had experience of this kind in Siberia. One of the special engineering problems they have had to deal with is the formation of surface ice ("nalyed") at points where the natural flow of subsurface or river water is blocked early in the winter, sometimes by an engineering structure. The ice itself in winter and the continuous thawing of large masses of such surface ice during the summer caused considerable trouble. A large number of Russian publications deal with preventive engineering measures and this article summarizes these measures. It was written by its distinguished author for publication through the American-Soviet Science Society in the United States.—Gregory P. Tschebotarioff, Associate Professor of Civil Engineering, Princeton University.*

SURFACE ICE FORMATION—"nayled" —frequently occurs in perma-frost regions, causing numerous difficulties to their development for habitation by damaging buildings and other structures and making roads impassable. The struggle against it is, therefore, one of the acute problems in areas of permanently frozen ground.

Until the Thirties of this century the struggle against the "nalyeds" had a purely passive character, being directed toward the liquidation of the consequences of the surface ice formational processes, with no consideration for the factors that caused them. One of the most common measures was the removal of surface ice by hand,—an arduous and ineffective task since the nalyed rapidly grew again because of the continuous supply and freezing of water. In some cases, rather peculiar anti-nalyed measures were adopted, for instance, when on one of the far eastern roads it was necessary to insure the continuous flow of water under a bridge and to prevent the formation of a nalyed in front of it. To that end some 40 cast-iron cauldrons were installed in openings cut in the ice cover of the river bed over a distance of 400 ft. upstream of the bridge. Fires were kept continuously burning in these cauldrons for four days.

A definite change in the method of approach to this whole problem took place at the end of the 1920's when M. I. Soumgin developed a theory of surface ice formation processes and gave a scientific basis for a broad program of anti-nalyed measures. In 1927, he recommended the following:

First, in road-location surveys in permafrost regions the attempt should be made to locate bridges and the road itself in places where the nalyeds are not apt to form. If this is not possible, then one should try to transfer the nalyed to a place where it will not be harmful. In the case of nalyeds formed by subsurface water, one should determine the direction of flow of the feeding spring and then intercept this flow some distance away from the road. This can be done by removing part of the soil over the water-bearing layer at the interception point to allow its rapid-freezing in winter. The water of the underground stream will then be blocked by the frozen layer and forced to the surface to form the nalyed at the location desired. It may even be advantageous in some cases to block the water bearing layer with a stone-cemented barrier founded on the underlying impervious stratum.

In the case of nalyeds formed by river water, Mr. Soumgin recommended attempting their control by deeping the river channel at chosen places or the transfer of the nalyed location by the removal of ice and soil across the valley upstream of the usual place of its formation.

These recommendations were tried out on a large scale during the construction of the Amoursko-Yakout highway in 1928-29 by V. G. Petrov, and gave quite satisfactory results. In subsequent years the Soviet anti-nalyed techniques were enlarged to include "warmth retention" in small channels, e.g., measures to prevent their freezing, but, these techniques are not yet fully perfected.

Nalyeds formed by surface water

All modern anti-nalyed methods can be sub-divided into two main groups according to the origin of the surface ice: e.g., whether it is formed by groundwater or by river water. The methods of defense against surface ice formed by groundwater can be divided into six categories:

(1) *General drainage of the area* removes the main cause of ice formation; e.g., water, and frequently lowers the upper level of eternally frozen ground to such an extent that structures can be built under normal conditions. However, soil drainage problems in eternally frozen regions have received very little study so far. Shallow (16 in. to 20 in.) ditches are most frequently used. They are not always fully effective, but even partial area drainage greatly reduces

later surface ice formation. Proper maintenance of the ditches is essential.

(2) *"Freezing belts"* are usually formed by wide but shallow (20 in. to 40 in.) ditches or strips of ground from which all vegetation and turf have been removed. This is the so-called permanent type of "freezing belt," as contrasted with the seasonal or snow type which involves removing the snow cover only. It is used in places where there is little vegetation, and is installed for the purpose of speeding the freezing of the underlying soil and accelerating the penetration of winter frost into the eternally frozen soil mass. A diagramatic sketch of such a belt is shown in Fig. 1.

An underground frozen barrier is created thereby which blocks the flow of water. As a result, all the phenomena accompanying a nalyed—heaving, the formation of ice blisters and the accumulation of surface ice—occur in front of the freezing belt.

The freezing belts are always placed across the direction of subsurface water flow and should extend somewhat beyond the limits of the subsurface stream. The width of the freezing belts is varied from 10 ft. to 15 ft. depending on the discharge of the stream. In plan the belts are usually given the shape of an arc, its convex side turned towards the structure which has to be protected; or of straight lines meeting at an angle of 160 to 170 deg. at the center of the belt.

In the case of small or medium sized nalyeds, one protective freezing belt of the permanent type is generally sufficient. In the case of a large discharge of water to the surface, one or two more additional parallel freezing belts have to be added. These supplementary belts usually are of the seasonal type. Since the latter require only the removal of snow, they can be installed very quickly and at little cost.

The distance between the belts should vary between 60 ft. and 300 ft., the closer spacing being used on steep slopes. The action of the freezing belts can be rendered more effective by the addition of a "wing," a 15-ft. to 30-ft. wide strip of land from which the turf has been removed and which adjoins the belt, as shown in Fig. 1.

The freezing belts require some maintenance, particularly during the summer to prevent deep thawing of the underlying ground. To that end,

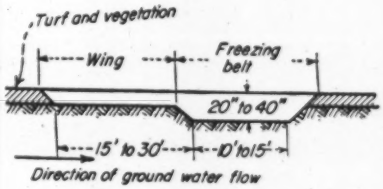


Fig. 1. Shallow, wide ditches, known as "freezing belts," speed the freezing of the underlying soil into a barrier across the path of subsurface water flow.

in the spring, the bottom of the belt is covered by a 12 in. to 16 in. layer of moss or of peat, which is removed in the fall. At the same time it is essential to drain off water from the belt, which otherwise, by filtrating into the soil, may more than offset the thermo-insulating action of the protective layer.

Snow has to be removed after each snowfall from both permanent and seasonal freezing belts and their wings. This has to be done only during the first half of the winter and is not necessary later.

(3) *Installation of Surface Barriers* generally is undertaken only when it is not possible or when it is too late to use freezing belts or to build channels to carry away the water that feeds the nalyed. Permanent barriers are built only when it is definitely established that the nalyed appears every year in the same place. They generally consist of earth levees designed to retain all the water feeding the surface ice of the nalyed and to prevent it from reaching the structure that has to be protected.

Levees up to 10 ft. in height have been built for the purpose. Gaps are left open in the levees at suitable places during the summer to permit the passage of summer surface water, and are then closed for the winter. The distance between the levee and the structure it protects varies considerably and depends on several factors; it should be no less than 60 ft.

Temporary barriers are installed mostly when a nalyed appears too suddenly to be controlled by other measures or when other measures have proved inadequate. Fig. 2 illustrates a simple type consisting of timber logs covered with snow, which is soon transformed into ice by the water of the nalyed. The barrier is increased gradually up to 6 to 8 ft. high and sometimes more. After the spring thaw the timber logs of the barrier are stored at elevated points in the vicinity so as not to be carried away by floods. Temporary levees built of snow alone are also employed in some cases.

(4) *The Widening of Cuts* is undertaken when small sized nalyeds are formed on slopes of rock cuts, the widening being done on the side of the spring that feeds the nalyed and to the extent necessary to accommodate most if not all of the ice formed during the winter. It is essential to prevent the ice reaching the road itself or having to be broken up and removed more than two or three times during the winter.

Cuts of this kind are, of course, expensive, and should be used only in extreme cases when no other preventive measures are possible.

(5) *Drainage of Feeding Water* is carried out in the case of springs flowing from below the permanently frozen ground and also in the case of surface springs when they have a considerable discharge. The water is then channeled away to a location where it can freeze without endangering the structure.

The usual method is to provide ditches of a cross section necessary for the free flow of the entire water feeding the nalyed. The water in the ditches is protected from freezing by the arrangement shown on Fig. 3. A layer of dry moss and peat approximately 20 in. thick is placed

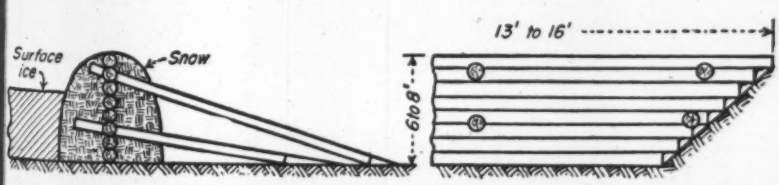


Fig. 2. Artificial timber barriers covered with snow are sometimes useful in protecting structures from nalyeds formed by groundwater.

in a loose condition over a cover of branches and timbers in the fall before the start of freezing weather. Snow is later placed over the moss without being tamped. Snow-catching screens can also be used for this purpose, and the moss cover can be omitted in regions where there is more than 12 in. of natural snow cover.

The entire protective cover is removed in the spring to raise as much as possible the temperature of the soil around the ditch.

(6) *The Transfer of Structures* may become necessary since new nalyeds sometimes appear in unexpected places after the completion of a structure as a result of local thermal and hydrogeological changes produced by it in the adjoining soil. In some cases, especially where roads are concerned, it may be preferable not to attempt to control the new nalyed, but to move away from it.

Nalyeds formed by river water

Methods of defense against surface ice formed by river water utilize some of the same measures used to combat surface water, but in a different manner. There are five main types of such methods:

(1) *Freezing belts* to intercept river water have to stretch across the entire valley and have to reach deeper into the ground than in the case of subsurface streams. The shore sections of the freezing belts are prepared in advance during the summer and the fall, while the channel sections are built step by step as the freezing of the river progresses. For the latter, a ditch is cut in the river ice to the full width of the belt, and then gradually deepened, care being taken not to pierce the ice below, and thus permit water to fill the ditch. In this manner the freezing of the entire channel is accelerated at the spot desired. The ditch is then sunk 10 to 12 in. into the channel bed, where it is given a width of 10 to 15 ft. The ice and the soil removed from the ditch are deposited on the downstream side, and the levee thus formed presents an additional obstacle to the expected nalyed.

Several such belts may have to be installed. The distance between them should not be less than 60 ft., and the belt closest to the structure should be not less than 300 nor more than 900 ft. from it. Provisions should be made for draining water away from the ditches of the belt. Wings 15 to 30 ft. wide may also be added on the upstream side by removing snow from the ice similarly to the manner shown on Fig. 1 for groundwater freezing belts.

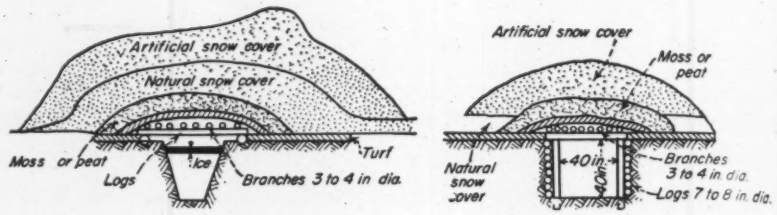


Fig. 3. Two methods of warmth retention in drainage ditches to prevent their freezing and forming nalyeds at undesirable points. Such protected ditches could carry water through a roadway fill which otherwise might form a nalyed-creating barrier. The protective cover is removed in the spring.

Maintenance of the belts consists in snow removal from the belt after each snowfall. Constant supervision also is necessary so that steps can be taken in time if nalyed water threatens to break beyond the belt after having filled it with ice.

(2) *Drainage of nalyed water* is carried out by means of open or covered drainage ditches whereby excess surface water is channelled to locations where it will be least harmful. In some cases, openings are cut in the ice of the river. This is done both on the upstream and the downstream sides of the structure and some 20 ft. from it. These openings are then connected by a ditch cut in the ice cover of the channel. The cross-section of the ditch is made sufficiently large to accommodate all excess water which usually flows out of the upstream opening under pressure. Both the openings and the ditch receive protective coverings to prevent their freezing and they require constant maintenance.

(3) *Barriers* used as a protection against river surface ice are of the temporary type only, such as has already been described for use against nalyeds formed by groundwater. They are built of timber or as snow levees, sometimes in several parallel rows. As a rule, the barrier closest to the structure should be not less than 300 ft. from it so that in case of a break-through the nalyed would spend itself before reaching the structure.

(4) *Deepening and Straightening of River Channels* are sometimes required. River nalyeds usually occur in places where the water flows in several shallow channels which, therefore, are liable to freeze quickly through their entire depth. It follows that a deepening of a channel and an increase of the velocity of the current in such places will decrease the danger of rapid channel freezing and of nalyed formation.

Maintenance of the straightened and deepened channels consists mainly in yearly dredging. Special attention should also be paid to the development of vegetation on the banks. This measure insures large accumulation of snow which helps to retain warmth in the channel banks.

(5) *"Warmth Retention" in Channels* to prevent their freezing is the latest anti-nalyed measure, which was first used on the Amoursko-Yakout highway during the winter of 1933-34. Observations showed that the highway had acted like a gigantic freezing belt and had caused the appearance of nalyeds in places where they had not been known to exist previously.

In some cases the nalyeds appeared near the road and continued to grow during the entire winter. It was obvious, therefore, that in the vicinity of the road the waterbearing soil layers did not freeze and did not present any obstacle to the flow of water until it reached the highway. There, because of the frozen barrier under the roadbed, the water was forced to the surface and formed a nalyed. The solution appeared to lie in the creation of conditions that would permit the subsurface water to continue freely flowing under the roadbed at the points threatened by nalyed formation. Typical of such points are the beds of small streams under bridges.

To combat this condition, measures are taken to retain warmth in the channels and to prevent their freezing. Then the water, having passed under the bridge along an artificially insulated channel, finds further down an unfrozen soil layer in its original natural condition and continues to flow without creating a nalyed.

The warmth-retaining measures consist in covering the channel section which needs insulation first by a layer of 12 to 18 in. of branches and brush. This forms the foundation for the insulation proper. When the channel is wide, wooden horses of simple construction are placed on the channel bed to provide support for the branch and brush foundation layer.

The insulation proper is achieved by snow which is used to cover the brush. In localities with little snowfall, dry loosely placed moss or peat is placed instead over the brush. (See Fig. 4). The insulating work should be completed before the first autumn frosts. Special attention should be paid to the protective insulation not only of the channels under bridges, but also of at least 3 ft. of the adjoining banks. The space between the insulating layer and the bridge above it should be filled with at least 20 in. of loose dry snow. In windy localities, snow shields are used for snow retention purposes and are placed along the insulated channel or ditch in such a manner that the snow is deposited over the channel itself. Spruce tree branches may be used instead of special snow shields.

Warmth-retaining measures in channels should be extended 60 to 300 ft. upstream and 60 to 150 ft. downstream of the structure. Good results can be obtained in ditches and small streams by creating an air gap under the ice cover. This is obtained by temporarily damming up somewhat the water in the channel before it freezes. After a 5 to 6 in. thick layer of ice has been formed, the dam is removed and the water level is lowered to its normal elevation. An 8 to 12 in. thick air gap is thus formed. (Fig. 5). The ice is then covered with snow or moss for further insulation.

Warmth-retaining measures in channels have many advantages, but

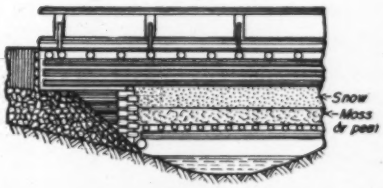


Fig. 4. Warmth-retention blanket installed beneath a bridge eliminates formation of a nalyed which might destroy the structure.

Fig. 5. An air gap between a layer of ice and the water surface will prevent water from freezing. To provide such a gap, a high ice layer is formed by temporarily raising the water surface with a dam downstream.

sometimes have to be combined with other anti-nalyed procedures of the types already described.

Maintenance of insulated channels consists in yearly removal of the insulation in the spring and its reinstatement in the fall. Moss and peat have to be stored in places where they will stay dry during the summer. No winter maintenance is required.

Conclusion

The above summarizes modern methods of struggle against the nalyeds. There is a sufficient variety of procedures to make a successful anti-nalyed defense possible. It should, however, be emphasized that the corresponding techniques are only in their initial stages of development. Manual labor predominates. Also no rational methods have yet been developed for a number of cases, such as the formation of nalyeds in railway tunnels; in regions with deep gravel deposits; on mountain slopes covered with boulders; and on large rivers when airfields have to be installed on their surface. Drainage of eternally frozen ground in general and the use of deep drainage for the channelling of groundwater feeding nalyeds in particular have received very little study. These are problems which have yet to be solved.

(A list of 18 Russian references to papers on nalyeds may be obtained from the American-Soviet Science Society, 58 Park Ave., New York.

Fort Worth Sanitary Program To Cost $4½ Million

Recommendations for extensive improvements to both the water distribution and sanitary sewer systems of Fort Worth, Texas, are contained in a recent report to the city council on a seven-months study of those utilities. Intended to meet the requirements of the two systems for orderly extension and enlargement during the next 20 years, the recommendations include for that period expenditures for water and sewers totalling $2,776,000 and $1,773,000 respectively.

Basis for design of the improvements is the estimated water consumption for 1970. This will require large-scale extension of water mains, and construction of two elevated storage tanks to supplement the five existing ones and equalize load factors on pumping and treatment installations.

In addition, capacity of the Holly pumping station is to be increased from its present 65 mgd. to 90 mgd., and a new booster pumping plant of 10-mgd. capacity is to be constructed to serve the high-pressure district.

Chief among the recommendations for improvement of the sanitary sewer system was that of constructing ventilating manholes at frequent intervals. This is to allow corrosive gases to escape, thus retarding deterioration of the pipe and prolonging its useful life. Some of the recommended maintenance and repair work is already under way.

Consulting engineers are Black and Veatch, of Kansas City, Mo., and Freese and Nichols of Fort Worth.

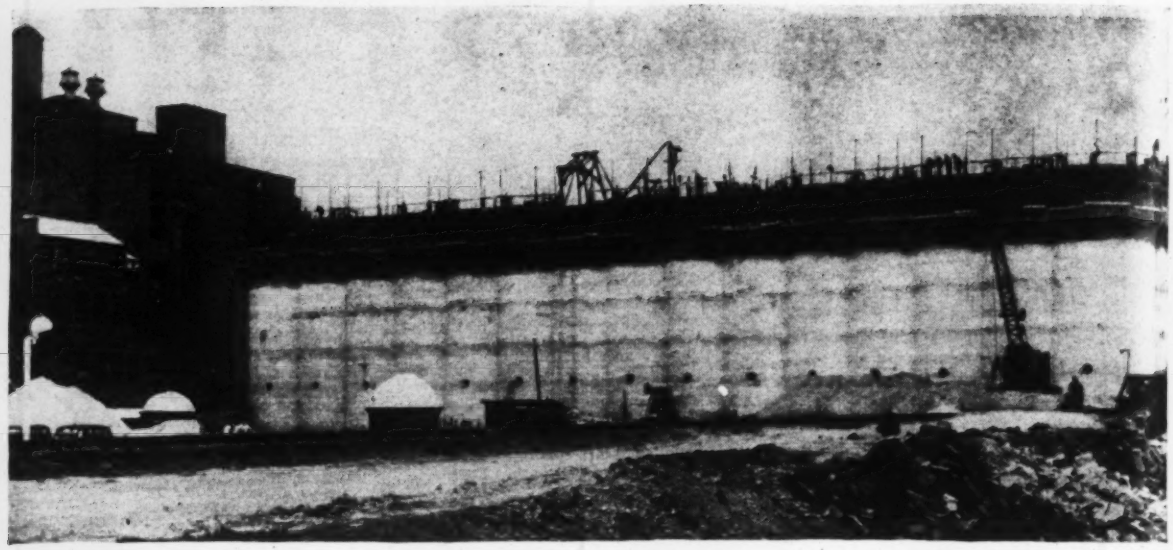


Fig. 1. Slip forms rise 10 ft. per day for 125-ft. high million-bushel soybean storage at Redfield, Iowa.

Slip Forms for Million-Bushel Elevator

H. R. Straight
General Manager, Iowa Soya Co.,
Redfield, Iowa

***Contents in Brief**—An assembly of ordinary 1 x 4-in. flooring set vertically and stiffened by chords of 2 x 10's held by inverted yokes was raised by screw jacks to serve as the forms for sixteen 125-ft. high concrete storage bins, poured from foundation to roof in a continuous operation. A work platform over the entire bin area was raised with the slip forms and served as support for a concrete roof. Cost was 20 cents per bushel of storage.*

UTILIZING SLIP FORMS for concrete wall construction, a million-bushel elevator for storage of soy beans has recently been completed for the Iowa Soya Co., at Redfield, Iowa. The elevator consists of sixteen 24-ft. diameter 125-ft. high concrete bins connected transversely in pairs by a short section of common wall. Longitudinally, the bins are at 30-ft. centers and a segment of an arc is used to connect the pairs on the outside so that each exterior has the appearance of fifteen bins of similar size. Actually, the areas between the bins are fully utilized for storage and the foundation is uniformly loaded.

Walls of the bins are 7 in. thick throughout the structure and require 40 cu.yd. of concrete per foot of height. Circular walls are reinforced with circumferential $\frac{3}{8}$-in. rods at 12 in. center to center for the lower 68 ft., and $\frac{5}{8}$-in. rod at the same spacing for the rest of the 125-ft. height. Smaller rods at closer spacing would have been more efficient, but were not obtainable. All exterior walls have $\frac{1}{2}$-in. vertical bars to take the differential strain of temperature change.

Interior and exterior forms for the walls were built up complete on the base and framed into a unit for the entire wall system. Vertical 1 x 4-in. flooring 4 ft. long was used as the contact surface, held in position by three

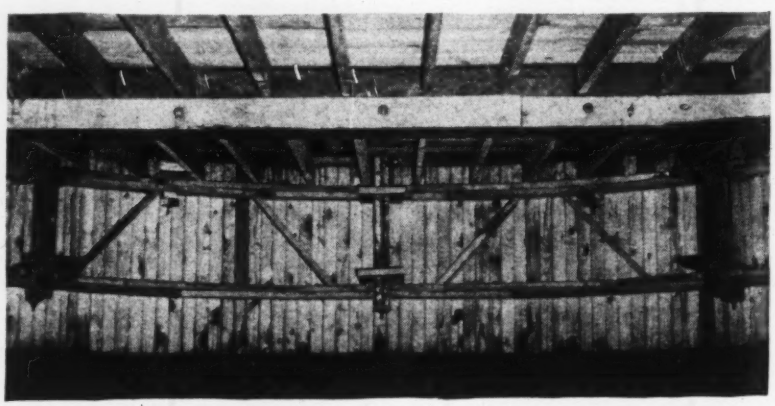


Fig. 2. Interior of form for 24-ft. dia. bin. The work platform rides up with the slip form and becomes the support for the poured concrete roof.

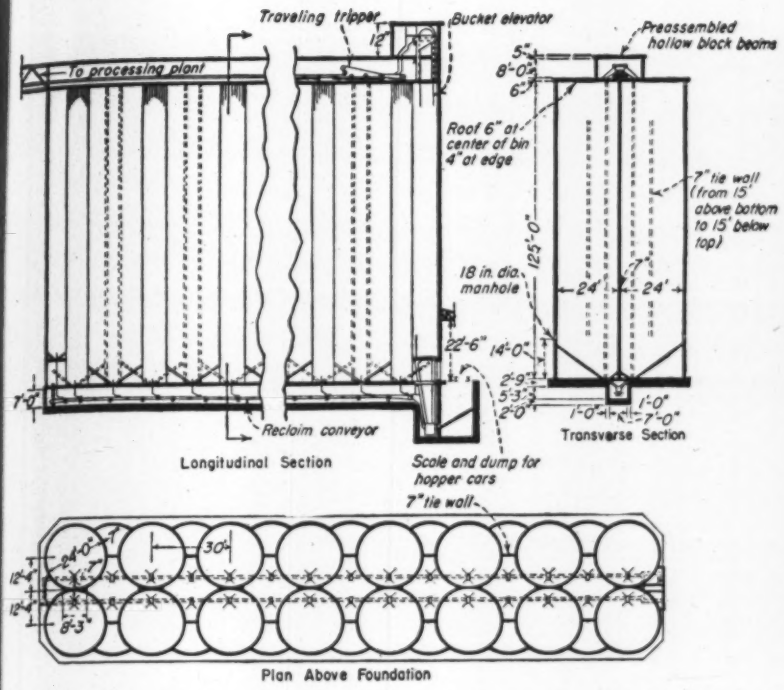

Traveling tripper
Bucket elevator
Preassembled hollow block beams
To processing plant
Roof 6" at center of bin 4" at edge
7" tie wall (from 15' above bottom to 15' below top)
18 in. dia. manhole
Reclaim conveyor
Longitudinal Section
Scale and dump for hopper cars
Transverse Section
7" tie wall
Plan Above Foundation

Fig. 3. Bins are connected transversely by a common wall and get longitudinal strength from the tie wall on the centerline of each row.

Fig. 5. Tractors with front-loading scoops proportioned the aggregates.

ply circular chords 6 in. below the top and two-ply chords 12 in. above the bottom. The chords were made of 2 x 10's sawed to make the segments for the inner and outer forms. Over the chords of both inside and outside forms a special yoke made of pressed steel or framed timber was used as vertical wales to space and position the form. Eleven such yokes were used for each of the sixteen separate bins and a total of 203 for the million-bushel elevator.

Screw jacks raise forms

Forms were raised by special screw jacks in the yoke frame reacting against a 1-in. vertical steel rod that rested on the base slab. Force of the jacks was taken against a collar clamped on the rod by means of set screws. When the threads of the jack were exhausted the jacks were backed up, collars on the 1-in. bar raised, retightened, and lifting continued. When the top of a 1-in. rod was reached (rods were in 18-ft. lengths) a 6-in. sleeve of 1-in. pipe, nicked in the center to prevent its slipping more than half way onto the lower bar, was used to hold the next bar above in place. The 1-in. rods were used in the center of the 7-in. wall for the full height of the structure and left in place, thus supplementing the vertical temperature reinforcing bars.

Concrete was placed continuously from the start of the job until the roof level was reached, with forms continually raised as the concrete set. Rate of progress was about 10 ft. per day, but could have been greater had the setting of concrete not been retarded by cold weather. Concrete was mixed at the site in two-bag batches, with about equal quantities of sand and coarse stone. To compensate for a lack of fines in the sand and secure a dense, watertight concrete, about 3 percent (of the volume of cement) of a wind-blown sand and 0.9 percent of a cement dispersing admixture were added to supplement the cement.

Fig. 4. Intersection of segmental arc wall. Note jacking yokes.

Mixers were set near the outside wall of the bin, and mixed concrete was hoisted in rubber-tired buggies or in a ½-cu.yd. bottom-dump bucket to the work elevation.

Work deck carried on form supports

The entire surface of the sixteen bins and the areas between them was decked over as a work platform, on which concrete buggies were wheeled to deliver material to forms. The platform was built on the sliding-form support and raised with it to the top of the bin structure. Concrete was placed throughout the entire structure in 3 to 6-in. increments and forms were raised ¼ to ½ in. at a time by a crew of twenty men moving continuously to successive screw jacks. The sliding forms were built with a "draw" of about ⅜ in. in 4 ft. and this, with a slight flexibility of the forms, permitted some variation in level without binding the forms.

When the sliding forms reached the top of the bin the inner form and work platform were left in place to

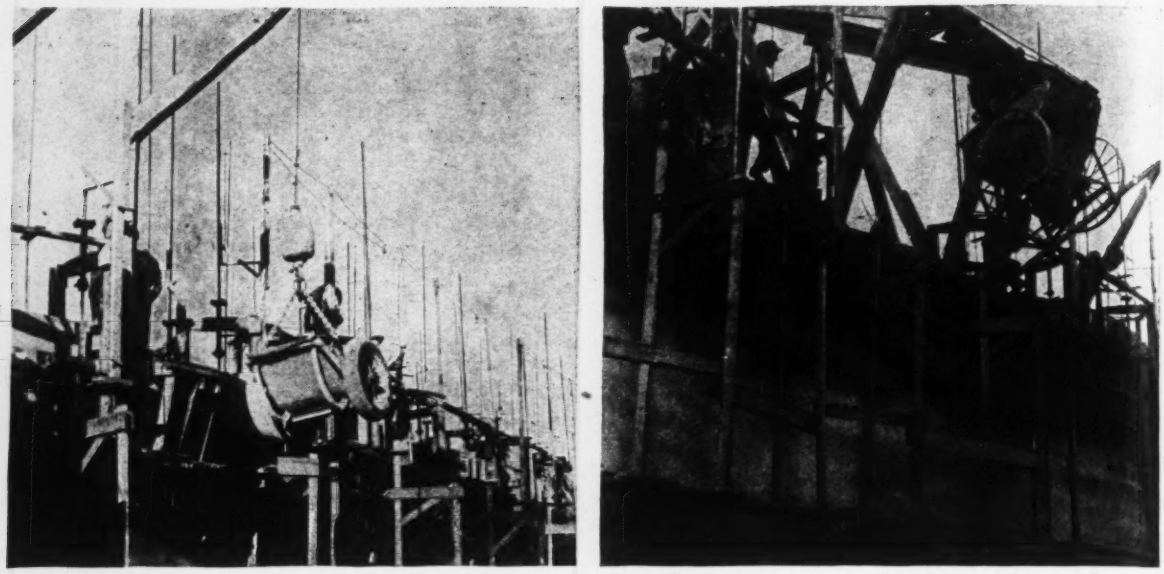


Fig. 6. Concrete was hoisted in buggy that was wheeled directly to the form (left) or in larger bottom-dump buggy that was used as a transfer bucket and was pulled in over the ever-rising floor on a sloping T-beam rig.

support a concrete roof slab. Angle irons on the steel beams that formed the principal structural members of the work platform were moved out to rest on the poured concrete wall.

Steel pins were driven into the 7-in. concrete walls just below the circular chords to help support the platform, following which the jacking devices, yoke structure and exterior forms were removed. Roofs of the bins are 6 in. thick at the center and 4 in. at the outside this slope providing the drainage.

Soybeans, which have become a most important product in Iowa, are delivered by trucks or rail and dumped into a 10,000 bushel per hour elevator that raises them to a 30-in. belt conveyor over the longitudinal center of the two rows of bins. A traveling tripper on the conveyor permits discharge at any desired point for delivery into any bin. The tripper can deliver back onto the main belt, so beans can be carried directly to the processing plant, located nearby but separated to meet safety and insurance requirements. Gate-controlled spouts below each bin and the spaces between bins permit gravity flow to a conveyor from which material is carried to the elevator for delivery to the plant or other storage by the upper conveyor.

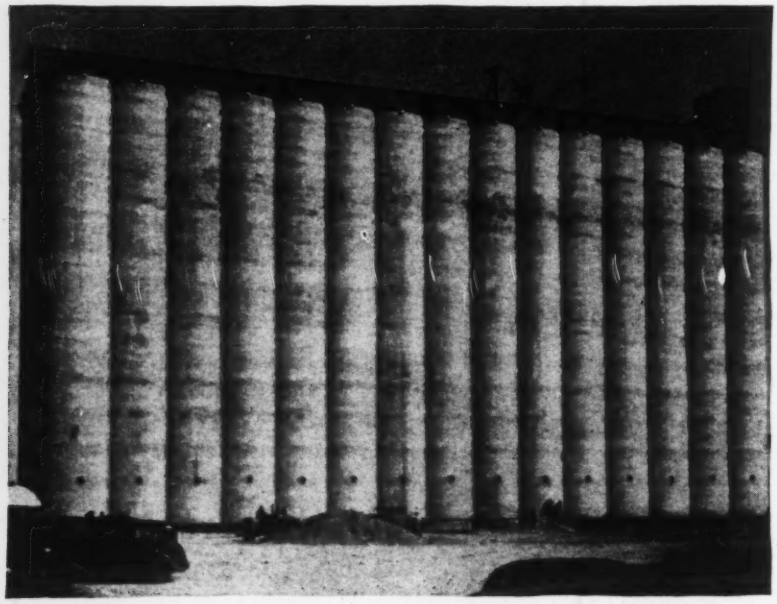


Fig. 7. A conveyor on top of the 125-ft. high bins delivers beans wherever required. Connecting arcs give the appearance of fifteen bins in each row.

The overhead conveyor is housed in a 16-ft. wide 10-ft. high head house. Roof beams, made-up in 16-ft. lengths from hollow tile using small rods for reinforcing were pre-assembled and ready for setting over the top of the head house, which was then given a top cover of concrete.

The bins were designed by Ryan Construction Co. of Omaha, Nebr. Conveying and handling equipment was planned by the author and Donald C. Ogg, partners in ownership of the Iowa Soya Co. Much of the machinery was built locally on account of slow delivery from regular sources of supply.

The Ryan Construction Co. supervised erection of the bins. Jack Grigg was superintendent, assisted by James Draper, in charge of the night shift.

Cost of the complete structure, with equipment, was about 20 cents per bushel of storage.

Valparaiso, Chile, Water Shortage Hastens Plans For New Supply System

A. T. Cook
Civil Engineer, Santiago, Chile

VALPARAISO, CHILE, a city of 280,000 inhabitants, is suffering from a water shortage that is serious enough to call for rationing of water during the coming dry months.

This shortage is the result of the combination of many elements among which are: the chronic scarcity of funds for construction work; the slowness of the government in getting new projects under way; and the critical shortage of materials during the last seven years. All of this has had the effect of public demands for the completion of plans for a new and more adequate supply for the city.

For many years, the major source of Valparaiso's water supply has been Penuelas Lake, an artificial body of water located eight miles inland from the city. This supply has never been satisfactory either in quantity or quality. The watershed draining into the lake is subject to periodic droughts and the lake is shallow at all times. During the dry summer months the semi-tropical sun and the shallowness of the lake combine to produce such profusive growths of algae that the waters become too unpalatable for drinking even after treatment and filtration.

Treatment ineffective in summer

Twenty-five years ago, when Valparaiso had a population of only 120,000 inhabitants, the need for a better and more adequate supply of water was recognized.

In 1923, an auxiliary supply was taken from the Aconcagua river near the mouth. This supply, with a maximum capacity of about 10 mgd., requires filtration and pumpage against a 400 ft. static head. Due to the high cost of both chemicals and power, it was used for some years only as an emergency supply.

But in 1939, Valparaiso's water consumption had increased to a point where both the Penuelas and the auxiliary supply had reached their safe production limit. During that year plans for the enlargement of the river supply and also for another source farther up the Aconcagua river were begun, but due to the shortage of materials the enlargement project became a war casualty and nothing was accomplished.

Since then, the rainfall for four successive years (1942 to 1946) has been less than normal, and depletion of the Penuelas storage has reached the point where only a few inches of coffee-colored and scum-coated water remain in the lake. If all of this remaining storage—about 660,000 million gallons—could be made available, it would be sufficient for only thirty days supply.

Leakage takes half of supply

To make matters worse, the distribution system of Valparaiso is so old and unreliable that of the 20 mgd. entering the system 51 percent is lost through leakage. When the Penuelas supply is exhausted the city will be reduced to the 10 mgd. available from the Aconcagua. What percentage of this supply will eventually reach the consumers in a system where the leakage exceeds the supply is a matter of conjecture.

Even if the necessary materials could be obtained to construct a larger auxiliary plant, it is now too late in the season for the enlargement to be of any service during the coming dry months.

The intake system for the new water system, on which work has already begun, consists of two galleries —each 2.5 meters in width by 2.15 meters in height and 2,000 meters in length—across the valley of the Aconcagua at a depth of 38 meters below the bed of the river. These galleries are located at Las Vegas and San Felipe. The Las Vegas gallery is estimated to collect 600 liters per second minimum. The San Felipe gallery will not be begun until the Las Vegas gallery is completed and its yield determined.

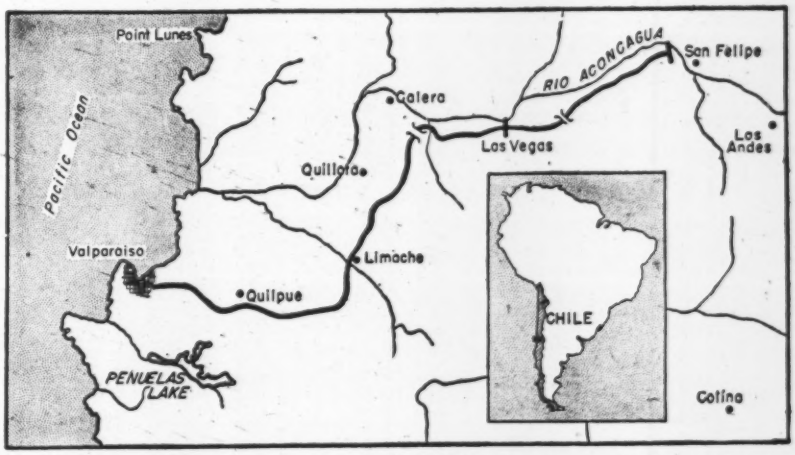
Tunnel lengths total 4,220 meters

From the Las Vegas gallery, an outlet tunnel 5,800 meters in length will bring the water to the surface by gravity, from where pipelines and tunnels will carry it 87,000 meters to Valparaiso. The route of the transmission main is over mountainous country. It will have ten tunnels running from 60 meters to 1,900 meters in length for a total of 4,220 meters; the pressure heads will be as great as 200 meters.

The preliminary estimates made by the engineers of the Valparaiso Public Works Department reveal the following lengths and sizes of pipe:

pipe dia.	lin. meters
51 in.	19,340
48 in.	23,920
45 in.	33,000
43.3 in.	7,320

The 45, 48 and 51 in. dia. pipe



Route of the proposed pipeline that will bring a new water supply to Valparaiso, Chile, from infiltration galleries on the upper Rio Aconcagua.

will be used to carry pressure heads up to 50 meters and the 43.3 in. pipe will sustain heads from 50 to 200 meters.

All things point to the probability that concrete will be selected for the pipeline. Sand and gravel are cheap and plentiful, and a high-class quality of cement is produced in the country. Reinforcing steel also is manufactured locally at a cost of 7½ cents per pound, f.o.b. foundry. On the other hand, no steel plates are made and the cost of steel plate is about 10c. per pound. Equipment for rolling is not adequate for a job as large as the Valparaiso pipeline, and welding materials are extremely costly.

Difficult access conditions

Some 50,000 meters of road will have to be constructed in order to transport the pipe as the greater part of the route follows steep mountain slopes at elevations of from 50 to 200 meters above the valleys. To complete the work within the specified time a large amount of equipment, including twenty air compressors, and considerable earth-moving machinery, will be needed.

The time fixed for the completion of the work is November 1948, or 24 months from date.

The Department of Public Works has estimated the work from Las Vegas to Valparaiso, including the Las Vegas gallery, at roughly 6,300,000 U. S. dollars. The portion from Las Vegas to San Felipe is estimated to cost $3,387,000.

Stanton Diagram Modification Gives Direct Solution For Pipe Flows

Henry J. Miles

Associate Professor of Civil Engineering
University of Southern California

In the usual problems involving computation of rate of flow through pipes, or the determination of pipe size required to satisfy certain conditions, a trial and error solution is frequently used. But others, notably Kalinski[1] and Rouse[2], have given methods for the direct solution of the former problem and a simplified solution of the latter by use of the Darcy formula and charts involving the parameter $Rf^{\frac{1}{2}}$ and $Rf^{1/5}$.

Because of the widespread use of the Stanton diagram ($\log f$ vs. $\log R$) as compared to charts using the aforementioned parameters, a simple graphical method of converting a typical Stanton diagram into one of the newer type may be useful.

The Stanton diagram (Fig. 1) plotted from data compiled by Pigott[3] is used as an example. Aim of the procedure is to obtain a plot of $\log f$ vs. $\log Rf^{\frac{1}{2}}$, and $\log f$ vs. $\log Rf^{1/5}$. Considering the former, since $\log Rf^{\frac{1}{2}} = \log R + \frac{1}{2} \log f$, by taking a number of points on the Stanton diagram (coordinates $\log R$, $\log f$) and moving each a distance $\frac{1}{2} \log f$ horizontally to the right, a plot of $\log f$ vs. $\log Rf^{\frac{1}{2}}$ is obtained.

This can be done more easily by drawing a series of lines at a slope of 2 to 1 (multiplied by the lengths of one cycle on the vertical and horizontal logarithmic scales, respectively) and at any convenient spacing, as shown in Fig. 1. The horizontal scale on the line $f = 0.01$ then becomes:

$$\log R + \frac{1}{2}\left(\log f - \log 0.01\right) = \log 10\, Rf^{1/2} = \log \frac{80.2\, D^{3/2}\, S^{1/2}}{\nu}$$

In a similar manner, if a series of lines is drawn at a 5 to 1 slope the horizontal scale becomes:

$$\log R + \frac{1}{5}\left(\log f - \log 0.01\right) = \log \frac{Rf^{1/5}}{0.01^{1/5}} = \log \frac{6.68\, S^{1/5}\, Q^{2/5}}{\nu}$$

How to use the chart

Some simple examples will serve to illustrate the use of the modified chart.

Example 1—Determine the rate of flow of kerosene at 60 deg. F. ($\nu = 2.5 \times 10^{-5}$) in a 12-in. dia. "average cast-iron" pipe (curve 6 on chart) 1,000 ft. long, if the head loss is to be 30 ft. of kerosene.

$$\frac{80.2\, D^{3/2}\, S^{1/2}}{\nu} = \frac{80.2 \times 1 \times 0.03^{1/2}}{2.5 \times 10^{-5}} = 5.56 \times 10^5$$

Locate 5.56×10^5 on bottom scale, go up to left at 2 to 1 slope until curve 6 is reached, and read $f = 0.019$ on left vertical scale. By substituting the known values in Darcy's formula, V is found to be 10.1 ft. per sec. When this is substituted in $Q = AV$, the value of Q is found to be 7.94 cfs.

Alternate solution—Locate 5.56×10^5 on bottom scale, go up to left at 2 to 1 slope until curve 6 is reached, drop vertically down to bottom scale and read Reynolds number $= 4.04 \times 10^5$. Then

$$R = \frac{VD}{\nu}, \text{ or } 4.04 \times 10^5 = \frac{V \times 1}{2.5 \times 10^{-5}}$$

from which $V = 10.1$ and $Q = 7.94$ cfs.

Example 2—Determine the diameter of "average cast-iron" pipe required to carry 7.94 cfs. of kerosene at 60 deg. F. if the head loss is to be 30 ft. of kerosene per 1,000 ft. of pipe. As in problem 1, $\nu = 2.5 \times 10^{-5}$ and $S = 0.03$. Substituting in $\frac{6.68\, S^{1/5}\, Q^{2/5}}{\nu}$, we get

$$\frac{6.68\,(0.03)^{1/5}\,(7.94)^{2/5}}{2.5 \times 10^{-5}} = 4.6 \times 10^5.$$

Now locate 4.6×10^5 on the bottom scale, go up to left at 5 to 1 slope until curve 6 is reached, and read $f = 0.019$ on left vertical scale. (In this problem it is necessary to assume that the required diameter falls within a range, here chosen as

NOMENCLATURE OF HYDRAULIC TERMS

- h_f Energy loss, ft. of fluid.
- f Darcy's friction factor.
- L Length of pipe, ft.
- D Diameter of pipe, ft.
- V Average velocity, ft. per sec.
- g Gravity, ft. per sec. per sec.
- A Cross-section area of pipe, sq. ft.
- S Hydraulic slope, dimensionless.
- ν Kinematic viscosity, sq. ft. per sec.
- R Reynolds number, dimensionless.
- Q Rate of flow, cu ft. per sec.

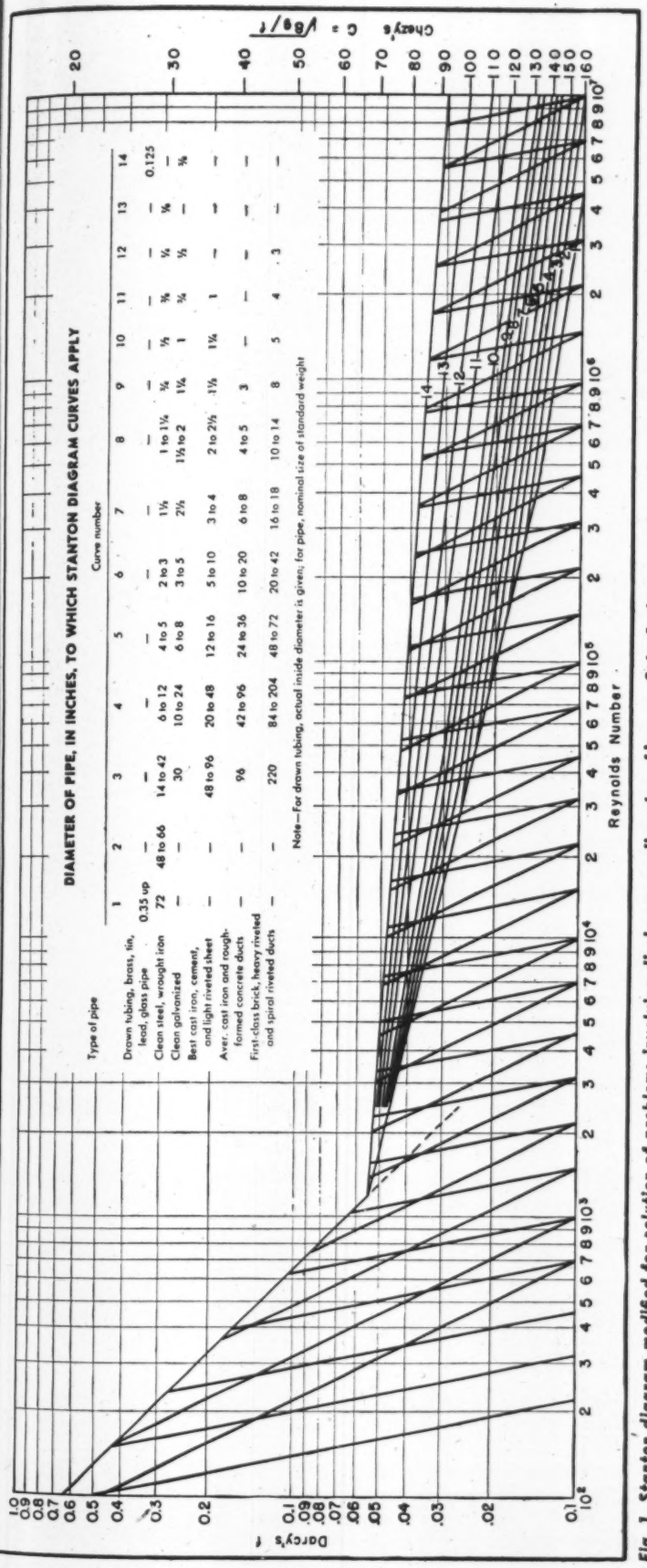

DIAMETER OF PIPE, IN INCHES, TO WHICH STANTON DIAGRAM CURVES APPLY
Curve number
Type of pipe
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Drawn tubing, brass, tin, lead, glass pipe 0.35 up — — — — — — — — — — — — —
Clean steel, wrought iron 72 48 to 66 14 to 42 6 to 12 4 to 5 2 to 3 1¼ 1 to 1¼ ¾ ⅝ ⅜ ¼ ¼ 0.125
Clean galvanized — — 30 10 to 24 6 to 8 3 to 5 2½ 1½ to 2 1¼ 1 ¾ ½ — ⅛
Best cast iron, cement, and light riveted sheet — — 48 to 96 20 to 48 12 to 16 5 to 10 3 to 4 2 to 2½ 1¼ 1 — — — —
Aver. cast iron and rough-formed concrete ducts — — 96 42 to 96 24 to 36 10 to 20 6 to 8 4 to 5 3 — — — — —
First-class brick, heavy riveted and spiral riveted ducts — — 220 84 to 204 48 to 72 20 to 42 16 to 18 10 to 14 8 5 4 .3 — —
Note—For drawn tubing, actual inside diameter is given; for pipe, nominal size of standard weight
Chezy's C = √8g/f
Darcy's f
Reynolds Number

Fig. 1. Stanton diagram modified for solution of problems involving discharge or diameter. Lines on 2 to 1 slope are for unknown discharge, on 5 to 1 for unknown diameters.

between 10 and 20 in., curve 6). Then since

$$hf = f\frac{L}{D}\frac{V^2}{2g} = \frac{0.025\, f\, L\, Q^2}{D^5},$$

$$30 = \frac{0.025 \times 0.019 \times 1000 \times 7.94^2}{D^5}$$

or $D = 1$ ft.

The Stanton diagram published by Moody[4] can be converted in a similar manner. However, since the vertical and horizontal scales have a ratio of approximately 3.31 to 1, the slanting lines would be drawn at slope of 2×3.31 (or 6.62) to 1, and 5×3.31 (or 16.55) to 1, respectively. Also the bottom scale on the $f = 0.008$ line would become

$$\log \frac{Rf^{1/2}}{0.008^{1/2}} = \log \frac{89.6\, D^{3/2}\, S^{1/2}}{\nu}$$

for unknown Q, and

$$\log \frac{R\, f^{1/2}}{0.008^{1/2}} = \log \frac{6.98\, S^{1/2}\, Q^{3/2}}{\nu}$$

for unknown D.

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3. R. J. S. Pigott, Flow of Fluids in Closed Conduits, *Mechanical Engineering*, Vol. 55, 1933, pp. 497-501.
4. L. F. Moody, Friction Factors for Pipe Flow, *Transactions*, American Society of Mechanical Engineers, Vol. 66, 1944, pp.. 671-684.

Tools From Steel Tires

Shortages of tools for upkeep of city streets caused the city of Seattle to experiment with making tools from scrapped locomotive tires during the war and postwar period. The result was that some of the unobtainable items, such as jackhammer gads, steam shovel points, etc., required for city use were made in city shops until regularly manufactured equipment could be obtained.

The locomotive tires have the quality of steel necessary for extremely hard use. Sections of the tires were first cut into required sizes by a welding torch, then shaped by drop forging and finally given an oil temper. Other emergency wartime repairs made by the city of Seattle included the forging of a truck axle and the machining of a power shovel axle from old locomotive axles.

The work was done by personnel of the city of Seattle, C. L. Wartelle, city engineer, and J. Robertson Jr., maintenance engineer.

Fig. 1. Salina Cruz harbor, the Pacific terminal of the new highway across the Isthmus of Tehuantepec, Mexico.

Tehauntepec Route Rehabilitation Undertaken by Mexico

C. S. Hill
Associate Editor, Engineering News Record (Retired)
Long Branch, N. J.

***Contents in Brief**—Two historic inter-ocean railway and terminal ports on the Isthmus of Tehuantepec, Mexico, are being modernized and a new trans-isthmus highway built. Both ports are being enlarged with new concrete and steel piers and warehouses, and modern power equipment for loading, unloading and warehousing is being installed. A notable device has been developed to prevent shoaling of the harbor entrance of Salina Cruz.*

MEXICAN ENGINEERS are rehabilitating the "Tehuantepec Route." The once world-known Tehuantepec trans-isthmian railway is being revamped; a parallel 3-lane concrete highway is being built, and the ocean ports at both terminals are being enlarged and modernized. The undertaking is one of major importance regionally, and in its promise to return to use a once-prosperous overland short cut for Atlantic-Pacific shipping it is significant for this country as well as Mexico. The engineering is on a broad plan to realize a long cherished Mexican ambition to see a potential geographical asset come to economic importance.

Panama, Nicaragua, Tehuantepec were in turn noted as possible "passes" by the Spanish explorers of the sixteenth century whose ships were nosing along and probing the shores of the great American isthmus in search of an open waterway. It is of record that, even that early, across-isthmus canals at all three locations were thought of as possibilities. Spanish engineers actually made "surveys" in 1534 for a Panama canal and in 1567 for a Nicaragua canal. Both projects were reported impossible. Combined pack-train and boat routes were set up and for almost three centuries such primitive transport served Spain at Panama and at Nicaragua. The Tehuantepec crossing was forgotten.

In the early 1820's Spain lost her continental American possessions. Then plan followed plan for Panama or Nicaragua canals and went through their brief existence almost as fast as the decades rounded until the turn of the century. Then came the present Panama Canal begun in 1904 and completed in 1913. Meanwhile the Tehuantepec crossing had developed as an Atlantic-Pacific trade route.

Mexico had declared her independence in 1821. For a score of years she was occupied in getting her vast territory under control. Then came her war with the United States from which Mexico emerged the nation south of the Rio Grande that it is territorially today.

Mexico at peace began to take account of her Tehuantepec pass. Here was the first break from the north in the great ranges of mountains that from Canada to Cape Horn bar the Pacific coasts of North and South America from territories to the east. There was less than 200 miles between oceans. Its location was more advantageous in ocean distances from North America than were the Panama and Nicaragua locations. It was in a better climate.

Fig. 2. The Tehuantepec Isthmus showing the railway and the new highway connecting the enlarged terminal ports at Salina Cruz and Puerto Mexico.

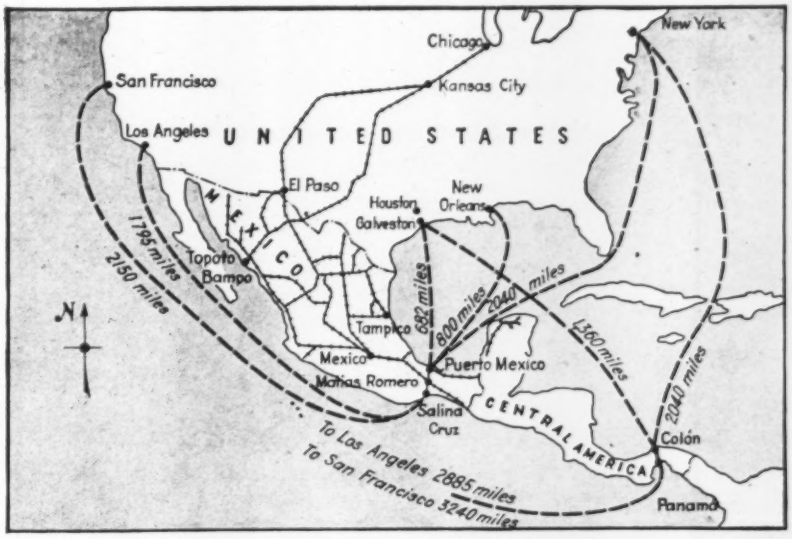

Fig. 3. Location of the Tehuantepec and Panama crossings in respect to sailing distances from United States ports.

The Panama R.R. had been completed in 1855. This was the only approach to a modern system of transport anywhere across the isthmus. The Mexican government turned its thought toward a railway across Tehuantepec. Many plans were hatched over the years but none matured. Mexico did not have the money. The United States was too frantically building her great railway mileage to put money into a Mexican railroad from nowhere to nowhere. For twenty years the Tehuantepec railway was merely wishful thinking. Then in the early eighties came a well-engineered plan for a railway to carry ships across the Mexican isthmus.

James B. Eads, with the triumph of the St. Louis arch bridge and the Mississippi River jetties behind him, interested himself in a crossing at Tehuantepec. This was about the time that DeLesseps started work on his Panama canal.

Eads' plan was well worked out. The crossing was to start at Coatzacoalcos on the Gulf of Mexico and called for deepening the Coatzacoalcos River for about 30 miles inland. At that point dock emplacements were to be built for submerged ship-cradles mounted on railway trucks. A ship was to enter the dock over the cradle which was then to be raised to embrace the hull evenly and securely. The cradle and ship were then to be pulled out of the dock onto three parallel standard-gage railway tracks and hauled across the isthmus by a locomotive on each track. At the Pacific port a similar dock was to receive ship and cradle; the ship was to be freed from the cradle to sail away, and the dock and cradle prepared to take on a ship bound for Atlantic ports. It was estimated that the rail trip would be made at a speed of about 10 miles an hour. (For details, see *Engineering News*, Feb. 14, 1885, p. 97)

Sixty years ago Eads' "ship railway" was not so chimerical as it seems today. The builder of the St. Louis arch was too realistic an engineer not to appraise loads and forces and to design his structures to resist them. Good engineering opinion of the period approved the ship railway plans as practicable. But the death of their author in 1887 ended promotion. (The ship railway scheme was revived this year by Modesto C. Rolland, manager of the Mexican Department of Free Ports, as a future possibility. *ENR* Sept. 12, vol. p. 336).

Meanwhile the Mexican government had been actively promoting the construction of a trans-isthmian railway. Numerous concessions were granted, and in 1831 considerable construction was done on the Tehauntepec Inter-Ocean R.R. under a concession granted to American promoters, but it was not until 1900

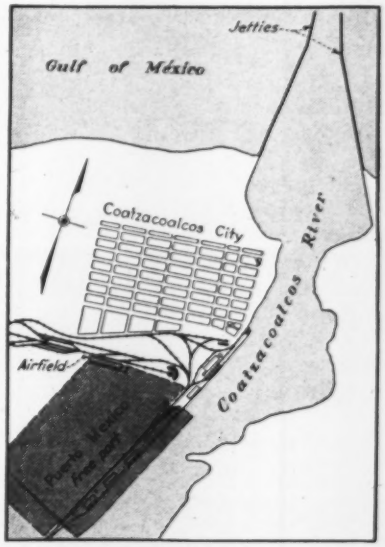

Fig. 4. Schematic plan of the new free-port harbor at Puerto Mexico, the Atlantic terminal.

Fig. 5. Puerto Mexico warehouses, showing the concrete and steel framing and double-gable roof. Part of wreck of old port-structures appears in foreground.

that success was achieved. The Tehuantepec R.R. was completed in 1907 with seaport terminals at Puerto Mexico and Salina Cruz, (See Fig. 2). This was about the time that the fourth Panama Canal Commission, with a final plan at last determined, really began to push construction of a canal across the Isthmus of Panama.

It was to be seven years before the first paying ship was to pass through the canal. Those were prosperous years for the Tehuantepec railway and its terminal ports. They were years that Mexico has never forgotten and never abandoned hope of seeing return.

Restoration undertaken

With the opening of the railway, the Tehuantepec route came quickly into recognition as an overland short-cut for the Atlantic-Pacific shipping trade. By paying transshipping costs at Tehuantepec, ships of both oceans were relieved of the long voyage around South America. For many cargoes the time and insurance saved more than equalled the cost of twice transferring them. Also, for United States ports, the short sail to Tehuantepec permitted the use of bottoms unfit for open sea trips around the "Horn", a distance of 21,534 miles.

The Mexican short-cut at best, however, could not compete with the completed Panama Canal, and after 1914 it was abandoned by inter-ocean shipping. Without through traffic the railway declined to local importance, the harbor at Salina Cruz silted up and port structures fell to ruin.

In the years that have followed one or two gestures toward revival have been made by the Mexican government. Under President Cardenas (1936-1940) some construction was done. It was not until the Puertos Libres Mexicanos recently took up the work that real progress was made. Now the new organization is prepared to spend $15,000,000 and construction is well advanced.

Economic foundation for the new developments is seen in these facts. First, the geographical conditions, Fig. 3, that once favored the Tehuantepec route still remain. Second, the Panama Canal is reaching its traffic capacity, and enlargement requires time even under the additional-locks plan already started. A sea-level canal at Panama, which has been actively advocated again, will require more time. The delay soon to be expected in finding passage at Panama will turn much shipping to the Tehuantepec route for relief. Third, with modern port equipment, cargo transshipment is not the tedious operation that it was thirty years ago. And finally, the new facilities of railway, highway and seaports afford quick export outlet to coffee and other products of a rich territory whose development is looked forward to by the Mexican government.

The work projected consists of port structures at Puerto Mexico and Salina Cruz, and of the across-isthmian highway and railway (the latter a revamping job) that connect the two ports. These are shown by the route map Fig. 2 and the schematic port maps Figs. 4 and 7. It is to be noted here that the port maps and the succeeding illustrations present most of the information on the plan and type of port structures and are to be studied accordingly.

So far, about $2,800,000 has been spent on the two ports. The work

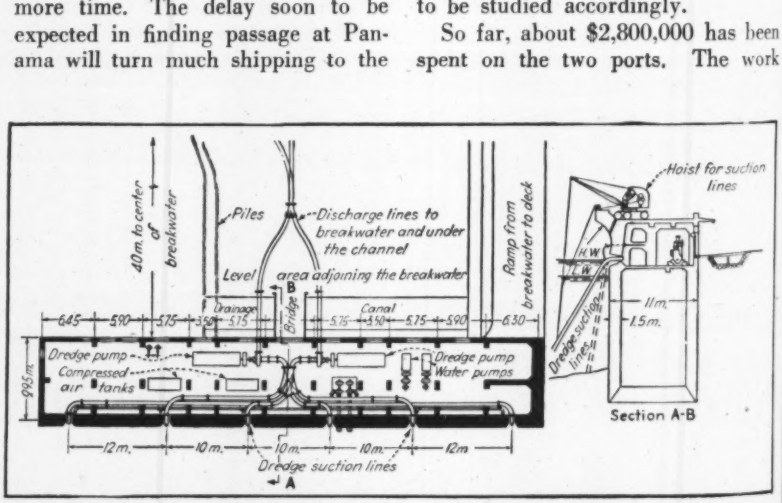

Fig. 6. Skeleton plan of the sand-pumping plant to prevent shoaling of the entrance channels at Salina Cruz harbor.

at Puerto Mexico has been the simpler in plan and in the structures required. As indicated by Fig. 4, the free port consists of a river-front wharf and five warehouses with an inshore area reserved for industries within the free zone. The wharf is 1,150 m. (3,375 ft.) long of concrete on steel piles and the warehouses are concrete and steel as shown by Figs. 5 and 7. Fig. 5 shows a part of the wrecked structure of the old port. The five warehouses have 20,000 sq. m. under roof and are served by an ample track system and all necessary equipment for loading, unloading and warehousing. Two river-mouth jetties fully protect a harbor with a minimum depth of 33 ft.

Pacific terminal facilities

At the Pacific terminal (Salina Cruz) the harbor is entirely artificial and of more elaborate plan. Jetties form a port area which is divided into an inner and an outer harbor by two piers as shown by Fig. 7. The piers are 1,640 ft. long and are of concrete on steel piles. The east pier and the adjacent areas constitute the free port. The pier structures as planned are indicated by the cross-section on Fig. 7. The completed structures are the wharfage and the three 125x32-m. (4,000 sq.m.) warehouses facing the inner harbor. The outer-harbor wharfage and three warehouses are under construction. These warehouses will inclose 6,240 sq. m. and the space between them will be roofed adding 3,468 sq. m. of covered area. The west, or customs-port pier has three 125x32-m. warehouses. All warehouses are of concrete and steel like those at Puerto Mexico, Figs. 5 and 7.

A complete pier and yard system of railway tracks will serve the harbor, Fig. 7. Other harbor accessories include: An 18,000-ton ship dry dock; a 2,460-hp. electric power plant serving the dry dock pumps, electric cargo cranes and other equipment and an oil terminal with tanks and pumping system with distribution outlets on the piers and for ships.

The project depth of harbors and channels is 10 m. (33 ft.) at low tide. At the outer-harbor entrance shoaling is a constant menace. Dredges now keep the channels open but a protecting jetty and sand pumping plant are under construction. The pumping plant, designated a draga fija (fixed dredge) by its designer, Modesto C. Rolland, manager, Puertos Libres Mexicanos, is unique.

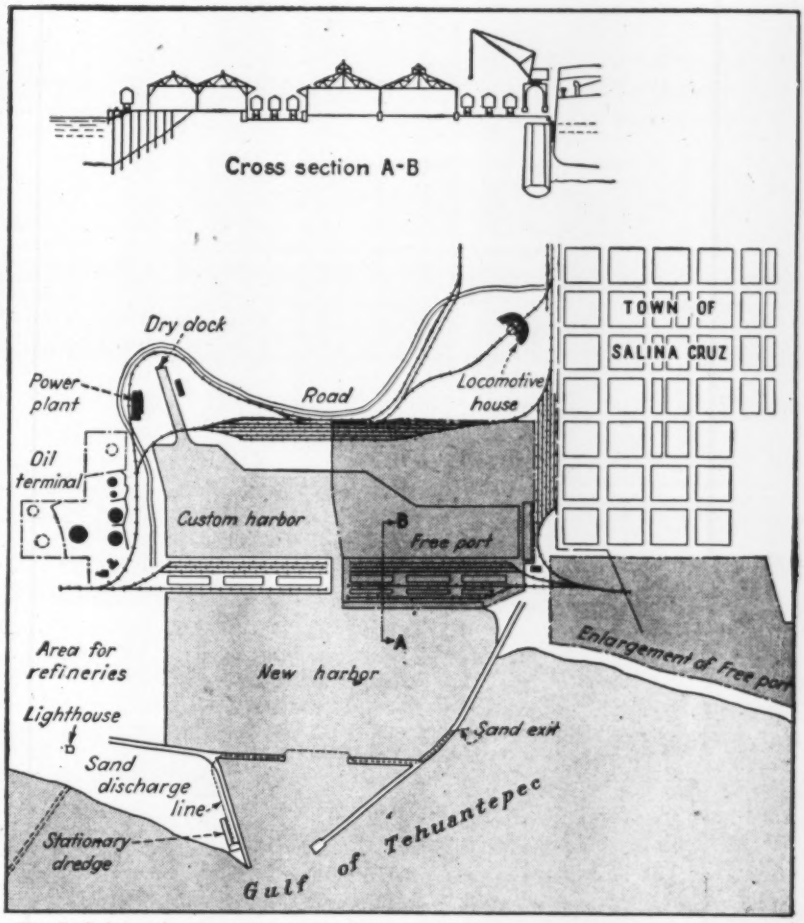

Fig. 7. Schematic plan of the new harbor at Salina Cruz with the supplementary port developments and devices to combat shoaling.

Along-shore currents from the west pile up sand against the west jetty and in the harbor mouth. The first defense planned is an outshore jetty 1 km. long west of the harbor. This is expected to divert the sand drift seaward and reduce the volume reaching the west jetty. Here the drift will be interrupted by the "fixed dredge" and taken by pipe line across and under the harbor entrance to the sea side of the east jetty.

Trans-Isthmus highway

The largest task in the Tehuantepec operations is the highway from Coatzacoalcos to Salina Cruz, about 170 mi. (Fig. 2). The road is expected to cost some $13,000,000 and about $5,000,000 has already been spent on construction. Starting at Salina Cruz the route is north to Tehuantepec about 11 miles, then for about 28 miles it follows the route and is a part of the Pan American Highway known in Mexico as the Camino Christobal Colon. At about La Ventosa the route is new through mountains, jungle and marsh to Coatzacoalcos and Puerto Mexico. In Fig. 2 note is made of the topography and particularly of the river system.

The road as projected will have a 3-lane concrete pavement 9 m. wide flanked by shoulders 1½ m. wide. Bridges will have the same clear width as the pavement. The maximum grade is 3 percent.

The operations at Tehuantepec are being carried out by Puertos Libres Mexicanos with headquarters at Mexico City. Modesto C. Rolland, an engineer, is manager, and E. Cardinault is chief of the technical department. Information concerning the current work was supplied to the Mexico City Bureau of McGraw-Hill World News by Mr. Rolland's staff.

New Arches Strengthen Old Trusses

Oscar Machado da Costa
Designer and Contractor
Rio de Janeiro, Brazil

THREE TRUSS SPANS on the Paraná Railway in Brazil, built fifty years ago and designed for very light loads, have recently been doubled in carrying capacity by the addition of new supports in the form of steel arches. The shortest span was 151 ft. and the longest 262 ft., the latter also being located 230 ft. above the bottom of the canyon that it crosses. Maximum stresses for the required future live load, if no reinforcing had been done, would have varied from 27,000 to 40,000 psi on the three bridges. After reinforcing the structures these maximum stresses will be in the neighborhood of 15,000 psi.

Perhaps the most interesting, although not the largest or most spectacular of the reinforcing operations was carried out on a 197-ft. truss. A flexible arched polygon was placed beneath the existing bridge (Fig. 1) and connected to it by seven latticed posts, thus changing the structure into an inverted one-span suspension bridge in which the original steelwork acts as the stiffening trusses. Some of the diagonals of the existing truss had to be stiffened to resist changes in sign of the stresses. Analysis of the resulting structure was made according to D. B. Steinman's translation of Professor Melan's book on Arches and Suspension Bridges, page 33.

Erection of the bridge was carried out on scaffolds hung by steel cables from the old trusses. The weight of the reinforcement was found to represent 32 percent of the estimated weight of a new structure with the same carrying capacity.

The second bridge reinforced (Fig. 3) was a two-span latticed continuous truss supported at the middle by a steel tower. By placing new two-hinged steel arches under each of the spans a considerable reduction in moment and shears in the original trusses was achieved, and the central tower was relieved of a large part of its load.

The new arches were designed to take all the truss dead and live loads. The influence on truss stresses of vertical deflection of the points of support was figured, and the design was adjusted so as to keep unit stresses within the specified limits. New verticals were placed over the new supports, and some of the original diagonals had to be stiffened to resist changes in sign of the stresses.

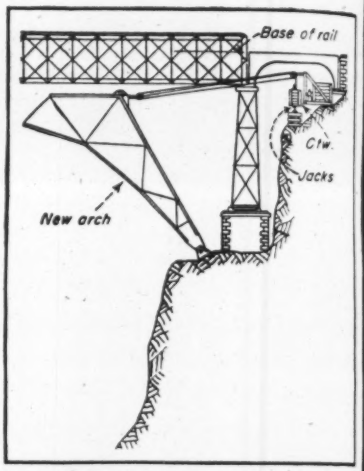

Fig. 2. Erection of Sao Joao bridge was aided by counterweighted block-and-tackle boldbacks.

In erecting the new work, hand hoists attached to the lower chords of the old trusses were used to raise the steel from the creek bottom and place it in position. As erection proceeded, one-half of each arch was tied by special tackles to the tower while the other half was held by cables attached to the ends of the old trusses. When the two halves of each arch were completed, they were rotated around the lower hinge pins until a pin at the center could be placed and the connecting joint riveted.

The computed unit stresses for the specified future live load of the bridge would have been 40,000 psi. without reinforcement; with the reinforcement these maximum stresses

Fig. 1. Flexible arch support converts old truss bridge into an inverted suspension span, the old construction acting as a stiffening truss.

ave been reduced to 14,220 psi. The eight of the reinforcement is 40 per- ent of the estimated weight of a new tructure with the same carrying apacity.

Reinforcing the Sao Joao Bridge

The most spectacular of the three ridge reinforcing jobs was that on ão João Bridge (Fig. 4), an old inville truss of 262-ft. span crossing deep canyon at a height of 230 ft. ere, too, the reinforcement used was two-hinged arch which provided our new intermediate points of sup- ort for the old truss. This structure as analyzed in accordance with elan's book, pages 270-273.

Erection of the arch reinforcing or this bridge was also carried out y lifting the steel from the bottom f the canyon, but on a more elabor- te scale than used with the preced- g bridge. Lifting was by means of special traveler running on the ld truss top chords and designed ith a portal through which regular ain service could be maintained. y reducing train speed to less than miles an hour, impact was elimi- ated and the resultant decrease in ve load stresses permitted the trav- er to be used safely.

Erection began with the placing of the arch shoes on prepared foot- gs, one of which had to be built up om the canyon bottom, serving so as strengthening for the existing er whose foundation rock had eathered rather badly.

With the shoes set, the legs of the ch were assembled, being sup- orted by cables tied back to the ex- ting steel towers. When the legs ere completed, these tieback cables ere replaced by a block-and-tackle nchorage system on either side, the ee end of the tackle being attached a counterweight consisting of a ooden box filled with iron bars and sting on four screw jacks (Fig. 2). With the steelwork held by these unterweighted tackles, erection was ntinued to the center of the span. ch counterweight was heavy ough to hold each half arch in uilibrium and exert a downward essure on the jacks. As time came joining the two halves of the arch a pin at the center of the lower ord, raising and lowering of these ks provided the necessary manip- tion. After the pin was placed the supporting cables were removed and the final top chord member in the panel over the pin was placed with no initial stress, so that the structure became for live load a two-hinged arch.

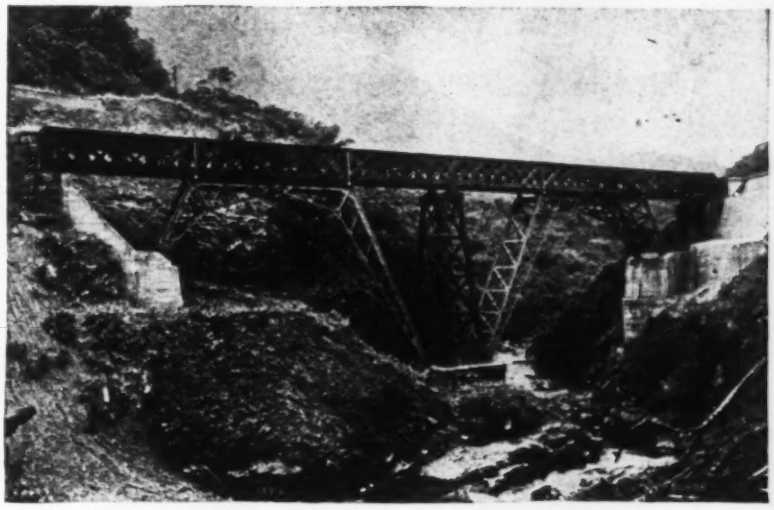

Fig. 3. Reinforcing arches under two-span continuous truss doubled its load carrying capacity.

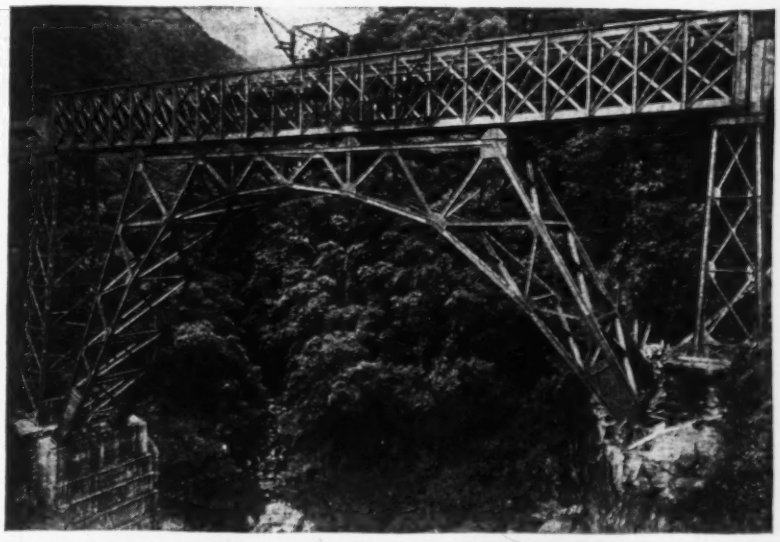

Fig. 4. High truss span of Sao Joao bridge is provided with four new supports by arch reinforcing. Hand-operated erection traveler on top chords of existing truss was designed to permit travel on the top chord and allow uninterrupted passage of railroad traffic during strengthening operations.

Without reinforcement, the São João bridge would have had maximum stresses of 33,000 psi. for the specified future live load; with the reinforcing the maximum stresses are reduced to 14,220 psi. Weight of the reinforcement equaled 60 percent of the estimated weight of a new structure with the same carrying capacity.

Most of the erection work on the three bridges was done by hand labor, the only available power-driven equipment being a 10-ton locomotive crane, a 150-cu.ft. portable air compressor and a ¾-yd. concrete mixer. Design, fabrication and erection was carried out by the writer's organiza tion of which he is chief engineer, Roberto Ozorio de Almeida engineer of design and José Filizola shop engineer. On the São João bridge, which was fabricated by the American Bridge Co., Alceu Moleta was resident engineer for the writer.

Specification for Light-Gage Steel Offers Rational Design Formulas

To assist engineers in designing structural members of sheet and strip steel by rational principles, rather than by rule of thumb, a "Specification for the Design of Light Gage Steel Structural Members" has been issued by the American Iron and Steel Institute. In addition to design provisions governing the most common shapes encountered, the specification includes four appendices containing illustrative sketches, design charts, design examples and explanatory material concerning the lateral bracing value of wall materials. This is the first time a comprehensive design specification for light-steel has been compiled.

Since 1930, a great number of systems using light-gage steel members have been introduced, primarily for residences and other buildings where loads and spans are moderate. One group of systems consists of sections used individually or preassembled into large framing panels before erection at the site. Members are installed at relatively close spacing —about 24 to 48 in. for floors and walls and 30 in. for roofs—and thicknesses range from 10 to 18 gage. Another prominent group, generally referred to as panel construction, has large surfaces integrally connected to the ribs or load-carrying parts. Steel roof deck is a special type of panel construction, usually shallower and lighter than the other forms.

The specification for the design of these thin structural members is the result of studies begun in 1939 under the Building Code Committee of the AISI and of research work carried on continuously at Cornell University for more than seven years under the direction of Dean S. C. Hollister and Professors W. L. Malcolm and George Winter. A technical subcommittee under the chairmanship of Milton Male, research engineer for United States Steel Corp. of Delaware, directed the work and prepared the specification.

In *ENR* Oct. 18, 1945, vol. p. 525, Mr. Male described some of the factors that influenced the development of the new design provisions. Additional considerations are outlined in the explanatory comments included in this first edition of the specification. In brief, although the basic design principles applicable to light-gage structural members are the same as those employed for the heavier conventional hot-rolled shapes, there are several supplementary conditions that must be investigated in the design of the lighter members. For example, the compression elements of cold-formed sections are frequently relatively wide and thin. Thus, care must be exerted to prevent local instability or buckling. The specification provides for this.

Unit stresses are intended for the nominal thickness of sheet and strip, and have been established at conservative values to allow for standard manufacturing tolerances. Three grades of steel conforming to the "Tentative Specifications of the American Society for Testing Materials for Light-Gage Structural-Quality Flat-Rolled Carbon Steel, A245-T and A246-T" are specified, with minimum yield point and allowable unit stress, respectively, for the net section of tension members and extreme fibers of beams, as follows: Grade C, 33,000 and 18,000 psi.; Grade B, 30,000 and 16,500 psi.; and Grade A, 25,000 and 13,500 psi. Other grades are allowed a unit stress equal to the minimum specified yield point divided by 1.85.

Stresses reduced to limit buckling

To provide for local instability and buckling, formulas are given for reducing the basic stresses. Based on the ratio of width to thickness, w/t, of elements, the allowable compressive stress in unstiffened components varies from the basic stresses for $w/t \leqq 12$ to 8,150 psi. for $w/t = 30$ and 3,690 psi. for $w/t = 60$.

The maximum compression in unbraced flanges is in addition limited to 250,000,000 divided by the square of the slenderness ratio (L/r).

On the gross area of a flat web, the maximum average shear stress is limited to two-thirds of the basic stresses or 64,000,000 divided by the square of the ratio of depth to web thickness (h/t). To avoid crippling of the flat webs of beams, concentrated loads are limited by formulas expressed in terms of web thickness, basic stresses and length of bearing. And the allowable unit stress in axially loaded columns is determined in terms of the slenderness ratio and a special factor, Q, which is defined in accordance with the use of stiffened and unstiffened elements in the composition of the member.

Although the specification permits design of stiffened compression elements at the basic stresses, it requires that the properties of the section, such as moment of inertia, be based upon a reduced or effective design width, the value of which is related to the w/t of the element and to the compressive stress.

Where the span of a beam is less than 30 times its flange projection from the web, the width of the tension flange is reduced for concentrated loads and loads spaced further apart than twice the flange projection. The effective width varies from 0.65 of actual for $L/w = 8$ to full width for $L/w \geqq 30$.

Lateral restraint of sheathing

In the design of steel compression members as studs, the specification takes into account the lateral bracing effect of collateral wall sheathing materials on the strength of the steel sections. A method is given for evaluating the lateral restraint wall materials are capable of providing, and formulas are furnished for determining the degree of lateral restraint required. The sheathing must be attached to both faces of the stud, and the spacing of attachments, a, should not exceed the radius of gyration multiplied by the square root of the ratio of 29,500,000 to the minimum specified yield point f.

The lateral restraint to be exerted by the wall is measured by a modulus of elastic support k, which is the ratio of a force in pounds F to the elongation in inches it produces in a strip of width a and of length equal to the distance between adjacent studs. This restraint should not be less than

$$k = \frac{f^2 a A^2}{240{,}000{,}000\, I}$$

where A is the area and I the moment of inertia of the stud.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Low-Cost Rack Simplifies Work of Emptying Oil Drums

A low-cost rack offering major advantages in emptying oil drums was built at a Pacific base by the 110th Seabee Battalion. The rack is of a type considered of value to state highway departments, contractors and other organizations receiving frequent deliveries in drums. Among the advantages offered are that it eliminates waste of oil, prevents contamination of the liquid with dust and dirt, and saves time.

The device consists of a framework of angle irons and pipes 6 by 14 ft. in plan and supporting a tilting rack. The latter is made of 2½-in. dia. pipe and provides six individual drum holders. Each holder consists of two parallel 3-ft. lengths of 2-in. pipe 12 in. on centers with ½-in. steel plates welded on their ends to retain the drums. The rack is mounted on a 2½-in. pipe shaft resting on four bearings made of reamed 2½-in. tees and couplings. To the 6-in. dia. pipe header located at the front of the rack are attached six 2-in. rubber hose connections.

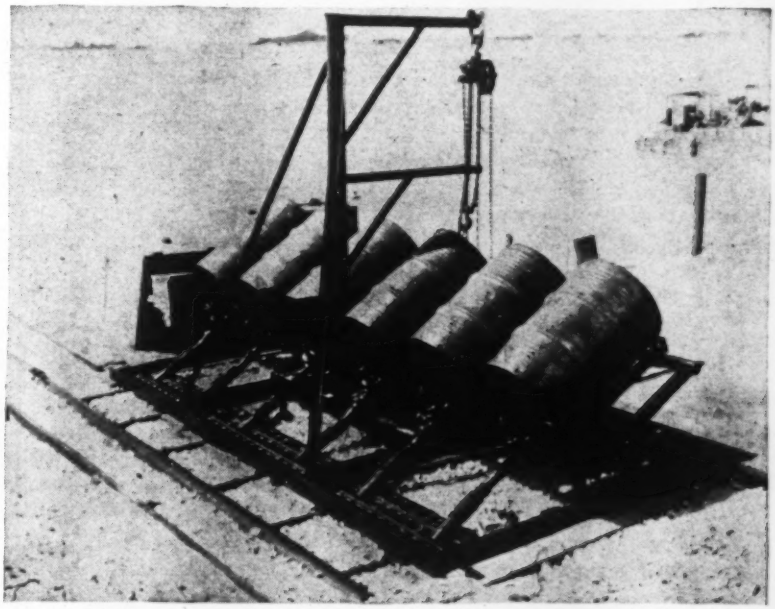

Fig. 1. Tilting rack built by Seabees of the 110th Battalion assures the complete removal of the contents of oil drums.

Movement of the rack is controlled by two overhead chain hoists and is limited by stops at the front and rear. The fittings, which include part of a union to connect with the hose and a valve, are mounted on the drums while they are still on end. After the drums are slid into place on the rack, the rear hoist raises the rack to a level position and the front hoist controls the movement from that point onward through the remainder of the operation of setting the drums in position for emptying.

In the layout illustrated, the header drains to a sump and the oil is pumped to an overhead storage tank from which tank trucks are readily filled. If overhead storage is undesirable the tanks may be placed underground and the trucks filled by pumping. On sidehills, a gravity layout might be possible although that has not yet been tried.

The Seabees report that a 4-man crew easily dumps 1,500 gal. per hr. with the rack shown.

The above description was abstracted from *Construction Battalion Activities*, which is an official Seabee publication.

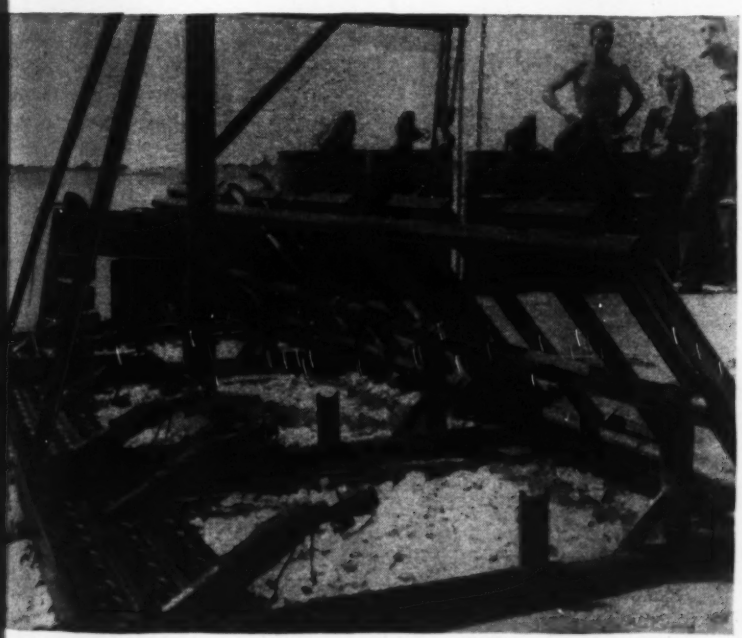

Fig. 2. Accommodating six drums, the rack is of welded construction and is mounted on a 2½-in. dia. pipe shaft.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Bolivia's Highway Plans

Sir: I was interested in the article by J. L. Harrison in your issue of Oct. 3, vol. p. 429 on Bolivia's economy and the Santa Cruz highway.

One may doubt the sweeping statements about the transformation of Bolivia's economy. As a matter of transportation economics also one may be permitted to doubt if a highway is the correct answer to this local problem of transportation between Santa Cruz, Oruro, La Paz, Uyuni, Potosi, etc.

The existing railway from Cochabamba reaches all the important cities of the Altoplanicie, Northern Argentina and the Pacific coast. It is there. It's extension to Santa Cruz has been on the tapis for many years. In my estimation it is the proper answer.

One finds that in many of these cases the problem is not approached from the standpoint of transportation, but from the standpoint of justifying a preconceived method of transportation. I think that has been the case with this project.

From the larger point of view one wonders how a country like Bolivia, which owes the people of the United States $70,000,000, which it makes no effort to pay or even pay the interest, gets an additional credit of $12,000,000.

FRED LAVIS
Consulting Engineer,
New York, N. Y.

A Veteran's Plea

Sir: I've written letters of application for every position advertised in your magazine that I thought I could fill, but have yet to receive an answer. Are the firms who submit such advertisements too big (or are they too small) to answer a letter? Even a postal card would do. At least I'd know that my letter had reached them.

I am a college graduate in civil engineering, where I specialized in highway engineering. I worked for the same firm 7½ years, when I was selected by them for a superintendent's job, and my training was along those lines. I started out as a water boy in 1929, at the age of 15, working for my dad, himself a general contractor, so I grew up in this business with the idea that, some day, I would be a construction superintendent. In the Army, after enlisting as a private I rose to the rank of major. Now I am out and willing to start over again, with a good decent firm, who will offer me a position leading to a superintendent's job, who will pay me enough that I can bank part of it every week, and live with reasonable well being and security. That should not be asking too much. For that type of firm I'll go anywhere and work like hell to show them that I mean what I say. But to date I have no takers.

A VETERAN

Editor's Note—Firms advertising for personnel should take this letter to heart. Not only do they have a moral obligation to answer all applicants, but it is poor public relations to fail to do so.

Tests on Welded Girders

Sir: Several editorial changes made in my article, "Temperature Effects Being Studied on Large Welded Girders" (*ENR* Oct. 17, vol. p. 502), might cause some misunderstanding. For example, the semi-killed steel hull plating material of girder No. 1 was taken from stock that had been furnished to meet the specifications of the American Bureau of Shipping, which, from all practical considerations, were the same as for ASTM-A7 structural steel for bridges and buildings. The special steel order for the other five girders carried a further provision that the steel be fully killed, which is not required by the American Bureau of Shipping specifications, nor by ASTM-A7.

The explanatory note added in brackets by the editor contained a typographical error. It should have read, "Fully killed steel is steel that has been sufficiently deoxidized (not oxidized, as stated) during manufacture, to prevent gas evolution during solidification of the metal".

Regarding the caption of the photograph, the total capacity, in compression, of the testing machine illustrated at the National Bureau of Standards is 10,000,000 lb. It was the strength of the available auxiliary supporting girders (resting on the platen of the machine) which determined the capacity of the testing arrangement.

Although mention of the effect of service temperature (or temperature at the time of testing) was deleted from the general statement of the purpose and objectives of the research program, I believe that this factor has been emphasized in the title and at several other points sufficiently to preclude failure to appreciate the very great influence of the temperature factor upon the ductility and toughness, as well as the fracture strength, of various kinds of steel materials.

A further examination of the third girder and of the data taken during its testing reveals the fact that the load had just levelled off prior to the end of the test, when the continued deflection was thought by the laboratory staff to be mostly due to sheering detrusion. Several small cracks had started on the bottom inside projecting edges of the side plates, where permanent deformations as great as 5 percent occurred, as compared with as little as 2.3 percent at some points in the tension flange.

The subcommittee in charge of the program has now decided to make the next (or fourth) test girder as nearly identical as possible to girders 2 and 3, and to test it at an intermediate temperature, perhaps 20 deg. above zero F., to obtain an intermediate point on the transition curve from ductile to brittle behavior. It is thought that such information will aid in correlating the behavior of a given material in a large structural member with its behavior in the kind of small specimens that might be used conveniently for laboratory tests of the material.

LAMOTTE GROVER
Welding Engineer,
Air Reduction Sales Company,
New York, N. Y.

UNIT PRICES BID BY CONTRACTORS

Platform Extensions to IRT Subway Stations, New York City

OWNER: Board of Transportation, City of New York.

PROJECT: Construction of platform extensions at the 103 St., 110 St., 116 St., 137 St., 145 St., 157 St., 168 St., 181 St., 191 St., and Dyckman St. Stations of the Broadway-Seventh Ave. Branch of the New York City Transit System, IRT Division, in the Borough of Manhattan. The work will be performed by trench excavation from the street surface except at the 168 St., 181 St., 191 St., and Dyckman St. Stations. Shafts will be provided at the 168 St. and 181 St. Stations. The Dyckman St. Station is located adjacent to the portal to the tunnel.

CONDITIONS: It will be necessary to take up and relay sidewalk and roadway pavement; to protect and support all structures, water mains, gas pipes, poles, and wires; to remove and reconstruct portions of the existing subway line; and to do station finish work. Contract is scheduled for completion 18 months from date of award. Some of the skilled labor wage rates stipulated are: structural ironworkers, $2.25 per hr., hoisting engine operating engineers, $2.25; blasters, $2.125; carpenters, $2.10; cement masons, $2.10; electricians, $2.00; composition roofers and waterproofers, $1.85; and curb setters, $1.75; semi-skilled labor rates are $1.875 for maintenance engineers; cement and concrete workers, $1.40; and asphalt workers, $1.27; unskilled labor rates are concrete rakers, $1.25; grade and concrete workers and laborers, $1.15; and tunnel laborers, $.95.

BIDS: Only two bids were received September 19, 1946, the contract low of $3,639,515.00 and the next bid of $3,782,372.50.

LIST OF BIDDERS:

1. Spencer, White & Prentis, Inc. New York, N. Y. (contract) $3,639,515.00
2. National Structures Corp., New York, N. Y. 3,782,372.50

	Item	Quantity	Unit Prices (1)	Unit Prices (2)
1	Earth excavation	6,100 cy	25.00	65.00
5	Rock excavation (trench)	5,400 cy	45.00	65.00
10	Rock excavation (tunnel)	4,000 cy	90.00	180.00
15	Decking	2,000 sy	40.00	30.00
17(a)	Tunnel timbering	125 Mbm	150.00	150.00
17(b)	Steel supports	200 ton	150.00	150.00
20	Concrete masonry	4,000 cy	60.00	70.00
21	Protective concrete masonry	650 cy	60.00	70.00
22	Finished surface on concrete	29,000 sf	.30	.15
30	Removal of masonry	2,750 cy	40.00	65.00
34	Grout of portland cement	1,000 bbl	18.00	20.00
40	Steel	750 ton	400.00	400.00
45	Steel reinforcement bars	45 ton	280.00	300.00
47(a)	Cutting of steel	6,000 si	2.00	1.00
47(b)	Drilling holes	17,500 ea	4.00	1.50
47(c)	Removal of rivets	2,850 ea	2.00	1.50
47(f)	Plugging holes	100 ea	3.00	5.00
50	Iron castings	4 ton	650.00	300.00
55(a)	Wire mesh beam wrapping	2,700 lb	1.00	1.00
60(c)	Waterproofing—3-ply	4,500 sy	5.50	3.00
60(d)	Waterproofing—4-ply	2,000 sy	6.50	3.50
61	Waterproofing—dry-ply	200 sy	1.25	1.00
63	Asphalt mastic	500 cf	7.00	4.00
64	Dampproofing concr. surf	250 sy	3.00	.70
80	Vit. clay tunnel ducts	19,200 dt f	.60	.50
82	Vit. R. R. ducts	4,500 dt f	2.00	1.00
125(a)	Roadway restored—(asphalt)	1,850 sy	15.00	7.00
125(g)	Roadway restored—(granite)	60 sy	24.00	15.00
126	Sidewalk restored	100 sy	6.50	7.00
128(c)	New curb (5" bluestone)	30 lf	10.00	6.00
128(g)	New curb (6" granite)	30 lf	12.00	10.00
129(ab)	Resetting old curb (5" bluestone)	190 lf	7.00	4.00
129(ag)	Resetting old curb (6" granite)	160 lf	8.00	5.00
132(a)	Temp. roadway pavement	1,900 sy	7.00	4.00
151	Maint. etc. B'way-7th Ave. Subway	lump sum	528,000.00	349,000.00
160(t)	Laying low-press. water pipe for 20"	50 lf	24.00	15.00
160(aj)	Laying low-press. water pipe for 36"	50 lf	30.00	20.00
166	New low-press. water & gas c. i. straight pipe	11 ton	200.00	110.00
167	New low-press. water & gas c. i. specials	7 ton	400.00	220.00
174 (h)	Laying 6" steel gas pipe	60 lf	8.00	10.00
205	Restoration vit. clay ducts	9,700 dt f	1.50	.60
217(d)	Maint. etc. steel pipe elec. ducts for 2"	50 dt f	6.00	1.40
217(e)	Maint. etc. steel pipe elec. ducts for 2½"	75 dt f	6.00	1.70
217(f)	Maint. etc. steel pipe elec. ducts for 3"	400 dt f	6.00	2.20
217(g)	Maint. etc. steel pipe elec. ducts for 3½"	75 dt f	6.00	2.80
220(g)	Furn. & laying new 3½" steel pipe elec. ducts	150 dt f	10.00	5.80
501-C	White glazed tile	34,000 sf	4.80	2.60
512(b)	Colored enameled tile	400 sf	6.50	3.30
513	Mosaic bands	4,600 sf	14.00	7.50
514	Mosaic name tablets	750 sf	24.00	13.00
514D	Weatherproof tile name tablets	25 sf	30.00	16.00
515F(a)	Mosaic placques on sta. walls	65 sf	20.00	10.00
515E(c)	Placques with I. U. T. with mosaic borders	200 sf	18.00	10.00
515E(e)	Tile placques with inscriptions etc	550 sf	22.00	13.00
515E(f)	Remove exist. tile wall finish	350 sf	6.00	3.00
519(a)	Marble wainscot for straight	210 sf	18.00	6.00
519 (j)	Removing & resetting exist. marble	125 sf	10.00	4.00
522G(a)	Plastering	75 sy	8.00	3.00
523(a)	Cement wainscot or base	2,600 sf	1.25	1.20
523(d)	Cement finish	80 sf	1.50	4.20
523(f)	1" floor fin. (mono.)	1,000 sf	.50	.30
523(j)	3" floor fin. (mono.)	22,000 sf	.60	.50
524M	Protective concr. for encasing cols	3,000 cf	12.00	10.00
527(a)	Front brick	3,850 sf	1.75	3.00
527(c)	Common brick	300 cf	5.00	4.50
528A	Weepholes	425 ea	.50	1.00
528-B	Anchors	1,200 ea	2.00	2.00
528-H	Hollow tile	3,700 cf	4.00	3.00
535K(a)	Kalamein doors type "A"	4 ea	400.00	150.00
535K(b)	Kalamein doors type "B"	6 pr	600.00	250.00
535S(fb)	Type "FbS" doors	3 pr	300.00	120.00
536-L	Removable screens	900 sf	18.00	3.00
540H(g)	Enameled sign plates	125 sf	18.00	6.00
540H(z)	Integral signs	100 sf	8.00	7.00
544(a)	Oak handrail	40 lf	6.00	2.00
546-B	Platform edge const	2,200 lf	1.25	1.50
554(b)	Steel elec. conduits—1"	6,000 lf	2.30	1.70
555(a)	4" x 4" x 2" outlet boxes	5 ea	11.00	10.00
555(b)	4" x 4" x 2" bottomless boxes & adapters	25 ea	8.00	7.00
555(c)	4" x 4" x 3" outlet boxes	400 ea	12.00	9.00
556(f)	6" x 6" x 4" c. i. pull boxes	30 ea	19.00	14.00
556-E(a)	6" x 12" x 4" ebony asb. boxes	8 ea	120.00	90.00
653	Removing c. i. collars at bases of c. i. cols	370 ea	5.00	5.00
850-FO	Precast concr. fence in place	75 lf	20.00	30.00
P-1007	Prot. exist. cables in manholes	130 ea	110.00	75.00
P-1008(a)	Furn. & install. 3-cond. 000 A.W.G. A.C. cables	5,400 lf	7.30	5.00
P-1008(b)	Furn. & install. 3-cond. No. 6 A.W.G. A.C. cables	1,500 lf	6.00	4.50
P-1009(a)	Furn. & install. single-cond. 2000 MCM-D.C. cables	4,200 lf	11.00	8.00
P-1010(a)	Furn. & install. cable supports—T-iron racks	320 lf	8.00	6.00
P-1010(b)	Furn. & install. cable supports—one way cable arms	36 ea	5.50	4.00
P-1010(c)	Furn. & install. cable supports—two-way cable arms	130 ea	6.10	5.00
P-1010(d)	Furn. & install. cable supports—three-way cable arms	80 ea	8.80	7.00
P-1010(e)	Furn. & install. cable supports—four-way cable arms	10 ea	11.00	8.00
P-1010(f)	Furn. & install. cable supports—porcelain saddle block insulator	600 ea	1.50	1.20
P-1011(a)	Remov. & deliv. 2.1" to 2.5" power cables	3,700 lf	2.50	2.00
P-1011(b)	Remov. & deliv. 1.5" to 2.09" power cables	5,600 lf	2.00	1.50
P-1012(a)	Remov. & reinstall. exist. cable supports—T-iron racks	25 ea	24.00	16.00
P-1012(b)	Remov. & reinstall. exist. cable supports—cable arms	130 ea	1.50	1.00
P-1012(c)	Remov. & reinstall. exist. cable supports—porcelain saddle block insulators	300 ea	.50	.50

Grading at Municipal Airport, Idlewild, New York

OWNER: City of New York, Department of Marine and Aviation; Downer, Green, and Carrillo, consulting engineers.

PROJECT: Work consists of general grading, construction of drains and cinder road, and planting beach grass at Municipal Airport at Idlewild. Site is located along Jamaica Bay in the southeasterly section of the Borough of Queens.

CONDITIONS: Since the present road to the construction area may be inadequate for trucking, additional access roads may

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LOW original cost and long life of Prufcoat make its application on all surfaces the lowest cost method of maintenance. For Prufcoat costs only slightly more per gallon than ordinary paint, costs no more to apply, *and yet provides positive protection against acids, alkalis, oil and water.* Thus, longer life and less frequent repaint jobs make maintenance savings certain.

Proved in hundreds of America's largest industrial plants during the past five years*, Prufcoat is being used today not only in areas where corrosion is severe, but on all structural steel and concrete, inside and outside. For Prufcoat cuts maintenance costs whether the corrosion problem is mild or severe.

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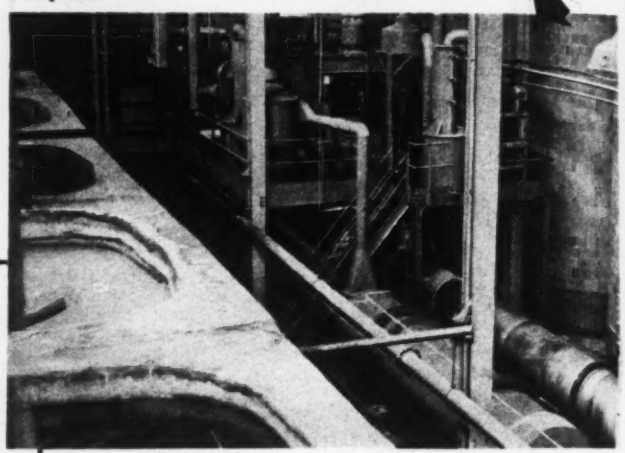

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Grading at Municipal Airport Idlewild, New York

(Continued from preceding page)

have to be provided by the contractor. Contract time is 300 calendar days. Stipulated wage rates are power-driven shovel operating engineers, $2.50; metallic lathers, $2.10; electricians, $2.00; excavating laborers, $1.20; and common construction laborers, $.95.

BIDS: Seven bids were received August 29, 1946, ranging from the contract low of $695,874.50 to $1,382,920.00. The low bid is 40 percent below the engineer's estimate of $1,166,640.00.

LIST OF BIDDERS:

1. Davis Construction Co. (contract) $695,874.50
2. Hendrickson Bros., Inc. 724,776.00
3. Gull-Defelice 897,623.50
4. Tully & Dinapoli 899,688.50
5. Tufano Contracting Corp. 980,981.75
6. Slattery Construction Co. 1,188,180.00
7. Delma Engrg. Corp. & Dilla Contracting Co. 1,382,920.00

	Item	Quantity	Unit Prices (1)	(2)	(3)
1	Earth excavation	1,350,000 cy	.375	.42	.54
2	Trench excavation	9,600 cy	1.00	1.25	1.00
3	Portland cement	325 bbl	3.00	3.00	2.50
4	1st class concrete (1:2:4)	200 cy	40.00	25.00	20.00
5	Bar reinforcement for structures	4,500 lb	.20	.08	.12
6	Miscellaneous metal	16,000 lb	.20	.20	.20
7a	Storm drain pipe—15"	700 lf	3.85	4.00	4.00
7b	Storm drain pipe—24"	200 lf	7.90	5.00	5.00
7c	Storm drain pipe—30"	650 lf	10.75	6.00	8.00
7d	Storm drain pipe—36"	730 lf	13.20	8.00	9.00
7e	Storm drain pipe—54"	1,800 lf	22.00	15.00	17.00
8	Cofferdams, pumping and draining	lump sum	20,000.00	15,850.00	24,000.00
9	Permanent sheeting and bracing	2 Mbm	200.00	200.00	250.00
10	Cinders—loose measure	2,000 cy	2.50	2.00	2.00
11	Timber and lumber—untreated	1 Mbm	200.00	200.00	300.00
12	Maintaining traffic	lump sum	3,850.00	3,500.00	10,000.00
13a	Leveling areas—area A	lump sum	1.00	1.00	1.00
13b	Leveling areas—area B	lump sum	9,000.00	12,750.00	10,000.00
13c	Leveling areas—area C	lump sum	6,000.00	10,500.00	10,000.00
13d	Leveling areas—area D	lump sum	3,000.00	4,500.00	5,000.00
14	Beach grass	250 ac	210.00	165.00	140.00
15	Sewer manholes adjusted	250 lf	18.00	10.00	20.00
16	Building demolitions	5 ea	400.00	50.00	100.00

Water and Sewer Extensions Roanoke Rapids, N. C.

OWNER: Roanoke Rapids Sanitary District, North Carolina, which includes the towns of Roanoke Rapids and Rosemary, together with some outlying territory in Halifax County, N. C. Consulting Engineer, William C. Olsen.

PROJECT: Extensions to existing water distribution system, consisting of 8 in. and 6 in. class 150 cast iron lines together with valves and hydrants, and extensions to sewer system, consisting of 8 in. sewer laterals with manholes and appurtenances.

CONDITIONS: Access to job site is by U. S. Highway 158, Atlantic Coast Line Railroad, or Seaboard Air Line Railroad. Gate valves will be furnished by the District. Material deliveries of sewer pipe are scheduled for March, 1947, and deliveries of water pipe, for eight months from bid opening. Contract time is 420 calendar days. Common labor wage rates approximate $.65 per hour.

BIDS: Three bids were received October 16, 1946, ranging from the contract low of $193,456.60 to $218,710.75.

LIST OF BIDDERS:

1. Blythe Bros., Charlotte, N. C. (contract) $193,456.60
2. A. H. Guion & Co., Charlotte, N. C. 209,983.40
3. F. D. Cline, Raleigh, N. C. 218,710.75

	Item	Quantity	Unit Prices (1)	(2)	(3)
	Section I				
1	8" cast iron pipe (cl. 150)	3,300 lf	$2.85	$3.00	$2.95
2	6" cast iron pipe (cl. 150)	26,858 lf	2.20	2.35	2.45
3	4" cast iron pipe (cl. 150)	19,490 lf	1.70	1.76	1.95
4	Cast iron specials	18,500 lb	.20	.20	.12
5	Installing 8" gate valves	4 ea	12.00	20.00	30.00
6	Installing 6" gate valves	32 ea	8.00	10.00	25.00
7	Installing 4" gate valves	65 ea	6.00	7.00	20.00
8	Fire hydrants	51 ea	105.00	125.00	150.00
	Section II				
1	8" vitrified clay pipe 0'–6' deep	15,784 lf	1.60	1.75	1.20
2	8" vitrified clay pipe 6'–8' deep	9,180 lf	1.75	1.85	1.60
3	8" vitrified clay pipe 8'–10' deep	3,255 lf	2.15	2.30	2.50
4	8" vitrified clay pipe 10'–12' deep	2,025 lf	2.50	2.75	4.00
5	8" vitrified clay pipe 12'–14' deep	557 lf	3.40	4.00	7.00
6	8" vitrified clay pipe 14'–16' deep	208 lf	4.60	5.00	10.00
7	8" vitrified clay pipe 16'–18' deep	31 lf	6.00	7.00	15.00
8	8" vitrified clay pipe 18'–20' deep	23 lf	8.20	10.00	25.00
9	8" vitrified clay pipe 20'–22' deep	10 lf	12.00	14.00	35.00
10	8" cast iron pipe 0'–6' deep	1,762 lf	3.00	3.00	2.85
11	8" x 4" wyes	1,200 ea	1.25	1.25	3.00
12	Manholes 0'–6' deep	87 ea	110.00	100.00	100.00
13	Manholes 6'–8' deep	20 ea	125.00	125.00	140.00
14	Manholes 8'–10' deep	7 ea	150.00	160.00	190.00
15	Manholes 10'–12' deep	5 ea	175.00	180.00	250.00
16	Manholes 12'–14' deep	1 ea	225.00	230.00	300.00
17	Manholes 14'–16' deep	1 ea	275.00	270.00	350.00
18	Manholes 16'–18' deep	1 ea	325.00	330.00	400.00
19	Connections to old manholes 0'–6' deep	18 ea	10.00	30.00	25.00
20	Drop manhole 10'–12' deep	1 ea	200.00	210.00	250.00
21	Drop manhole 12'–14' deep	1 ea	250.00	260.00	300.00
22	Drop manhole 14'–16' deep	1 ea	300.00	300.00	350.00
23	Drop manhole 16'–18' deep	1 ea	350.00	350.00	450.00
24	Convert manhole to drop 10'–12' deep	1 ea	50.00	80.00	50.00
25	Convert manhole to drop 12'–14' deep	1 ea	60.00	80.00	50.00
26	Convert manhole to drop 18'–20' deep	3 ea	80.00	100.00	75.00
27	Convert manhole to drop 20'–22' deep	1 ea	100.00	120.00	100.00
30	Rock excavation	50 cy	10.00	12.00	20.00

Intercepting Sewer, Chicago, Illinois

OWNER: Sanitary District of Chicago, W. H. Trinkaus, Chief Engineer.

PROJECT: South side intercepting sewer in Cook County, Chicago, Ill. Work involves the laying of a sewer line, 18 ft. internal width, 17,000 lin. ft., and the laying of a line, 15 ft. internal width, 500 lin. ft. Rock will be encountered and must be excavated.

CONDITIONS: All materials are to be furnished by contractor. Contract time is 900 calendar days. Wage rates for skilled labor range from $1.675 to $2.25 per hour; for semi-skilled labor, from $1.35 to $1.675; and for common labor, are $1.30.

BIDS: Only two bids were received September 12, 1946, with the subsequent contract award for $9,492,450.

LIST OF BIDDERS:

1. S. A. Healy Co., Chicago, Ill. (contract) $9,492,450.00
2. Peter Kiewit Sons Co. and Paschen Contractors, Inc. Chicago, Ill. 9,991,200.00

	Item	Quantity	Unit Prices (1)	(2)
1	Sewer, 18' internal width	17,000 lf	$492.00	$519.00
2	Sewer, 15' internal width	500 lf	300.00	434.00
3	Standard manhole	1,200 lf	55.00	50.00
4	Offset manhole bases, type no. 1	19 ea	700.00	600.00
5	Offset manhole bases, type no. 2	3 ea	3,500.00	2,650.00
6	Offset manhole bases, type no. 3	2 ea	5,000.00	3,500.00
7	Offset manhole bases, type no. 4	7 ea	6,000.00	4,000.00
8	Concrete bulkheads	90 cy	80.00	75.00
9	Removal of concrete bulkheads	90 cy	45.00	50.00
10	Timber bulkheads	30 Mbm	225.00	200.00
11	Removal of timber bulkheads	30 Mbm	125.00	100.00
12	Reinforcement bars	5,500,000 lb	.08	.08
13	Iron castings and miscellaneous metals	33,000 lb	.30	.20
14	Rock excavation	31,000 cy	10.00	10.00
15	Additional earth excavation in tunnel	400 cy	6.00	6.00
16	Additional earth excavation in open cut	400 cy	2.00	2.00
17	Additional concrete, class A, in tunnel	400 cy	16.00	16.00
18	Additional concrete, class A, in open cut	400 cy	14.00	14.00
19	Additional concrete class B	400 cy	12.00	12.00
20	Field office	1 ea	35,000.00	40,000.00

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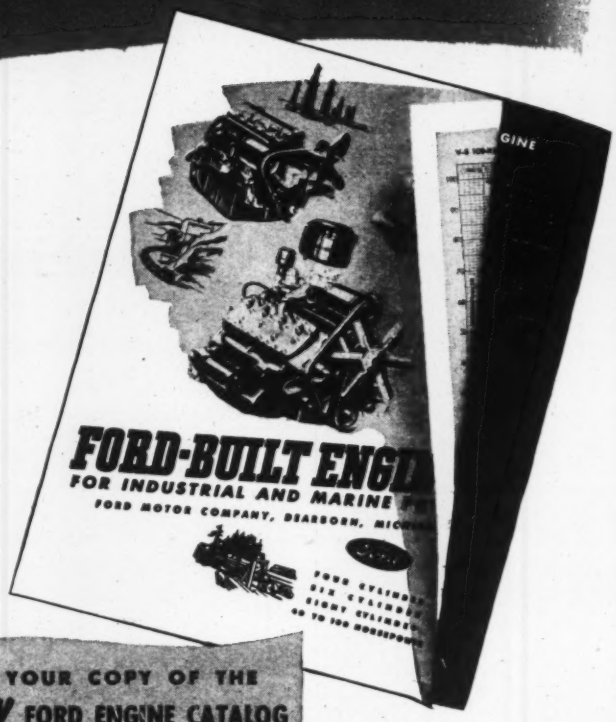

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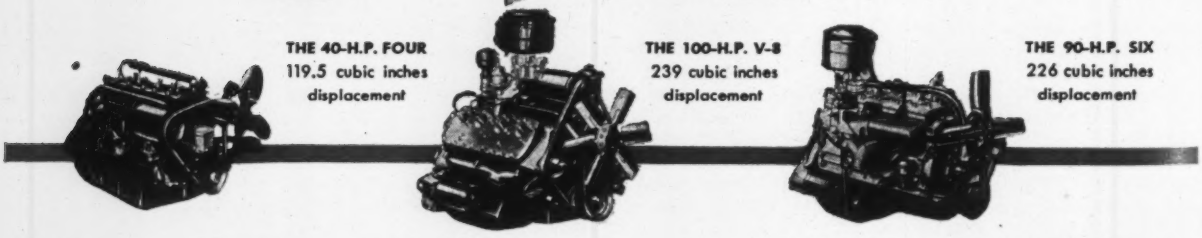

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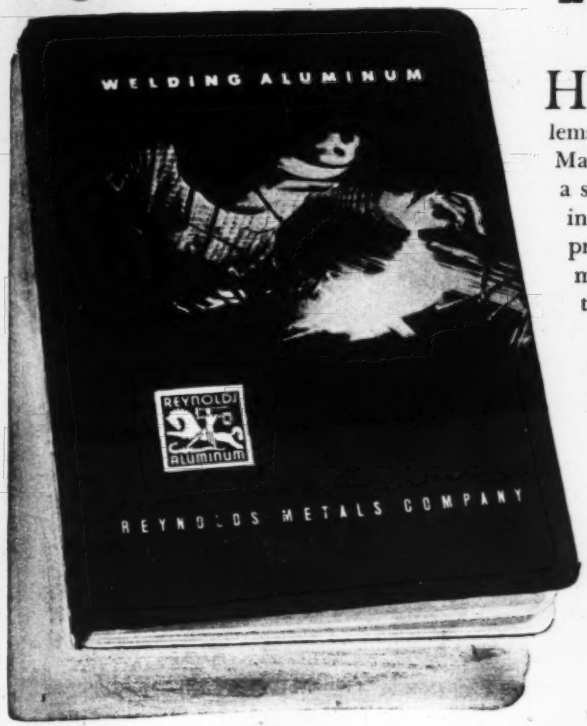

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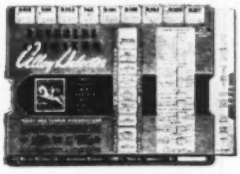

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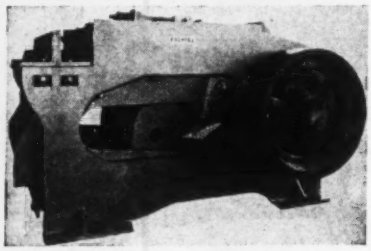
Wood-Lok glue colors range from pure white, which dries colorless and leaves no glue line, to darker shades for special uses.—*National Adhesives, 270 Madison Ave., New York 16, N. Y.*

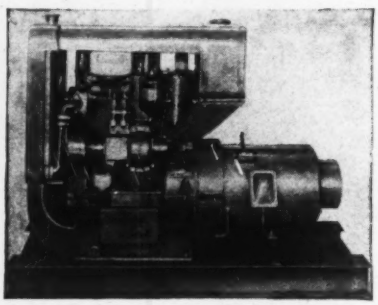
Front-End Loader—New small-tractor loader, built for mounting on Cletrac HG-42 track-type tractor, has ⅜ or ½-yd. bucket and high dumping clearance of 96 in. Overall height is 90 in. in digging position and 60 in. when bucket is in carrying position. Bucket pivot point is a few inches back of load center, thus increasing dumping distance. Built-in radiator guard protects front end of tractor and serves as oil expansion chamber. Two double-acting hydraulic rams, powered by a front-mounted pump, raise and lower bucket. The entire unit, including loader, hydraulic pump and tractor, weighs 5,250 lb. Bucket can be quickly interchanged with bulldozer bowl or angle bowl attachment. — *American Tractor Equipment Corp., 9131 San Leandro Blvd., Oakland 3, Calif.*

Model 40 Controller—A new controller for temperature, pressure, flow or other variables embodies improvements in design and construction which offer advantages of simplification of design, with more sturdy unit construction, flexible adjustments, and new convenience in servicing, including the easy replacement or interchange of unit parts.—*The Foxboro Co., Foxboro, Mass.*



Two-Stage Crusher — This 9x40 crusher will take a full size 9 in. stone. Under actual operation it produced over 40 tons per hour with the jaws set at ¾ in. on the closed stroke. Eighty percent of the product passed through a ¾ in. square screen.—*Ebersol Crusher & Engineering Co., P.O. Box 962, Lancaster, Pa.*

"Departmental" Compressors — New compressor units are available in 60, 105, 160, 210 and 315 cfm. sizes, designed for installation in individual plant departments and as replacements for large central compressor systems. —*Davey Compressor Co., Kent, Ohio.*

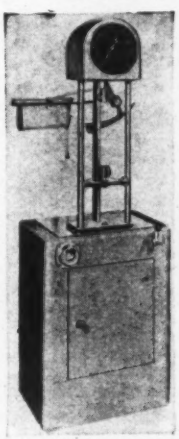


Diesel A.C. Generating Sets—Recently developed "Regulectric" system, utilizing a novel built-in circuit, is simple, compact, foolproof and without moving parts. Adopted as standard equipment on diesel-driven A-C generating sets of 5 to 15 kw. capacity it maintains a normal variation of 2 percent from no load to full load. Other Sheppard generating sets are available up to 36 kw.—*R. H. Sheppard Co., Hanover, Pa.*

Masonry Saw—New Model EKD saw has a knock-down style frame designed for assembly with bolts. Cutting head is completely welded and assembled. Only frame need be dismantled when transporting saw from job to job. Variety of frame sizes can be used with 12- or 14-in. blades.—*Clipper Mfg. Co., 4030 Manchester St., St. Louis 10, Mo.*

Heavy-Duty Trucks —Thirty Dodge truck models are available in 60 gross vehicle weight classifications ranging up to 23,000 lb. and in tractor-trailer ratings up to 37,000 lb. New line includes 2½-ton truck of 18,000-lb. gross vehicle weight in five wheelbases ranging from 136 to 235 in.; 3-ton truck of 20,000 lb. gross vehicle weight in five wheelbases ranging from 136 to 196 in., and 3-ton heavy-duty truck of 23,000 lb. gross vehicle weight in five wheelbases ranging from 136 to 196 in.—*Dodge Division, Chrysler Corp., Detroit 31, Mich.*

Low-Range Tester—Built for lighter materials or small finished items, tester has four separate capacities, each available instantly and shown individually on large dial. These ranges are 0-10 lb. in 1-oz. dial divisions; 0-25 lb. in 2 oz.; 0-50 lb. in 4 oz.; and 0-100 lb. in 8 oz. Overall height is 63 in. and net weight is 162 lb. Lower grip travel is continuously variable from 0 to 19 in. per minute. Unit has one half of one percent accuracy, pendulum action, max-load reading, featherweight and swivelled upper grip, stroke limiting switches, forward-reverse switch, elongation gage, and stress-strain recorder.—*W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill.*



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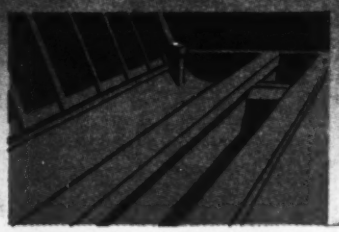

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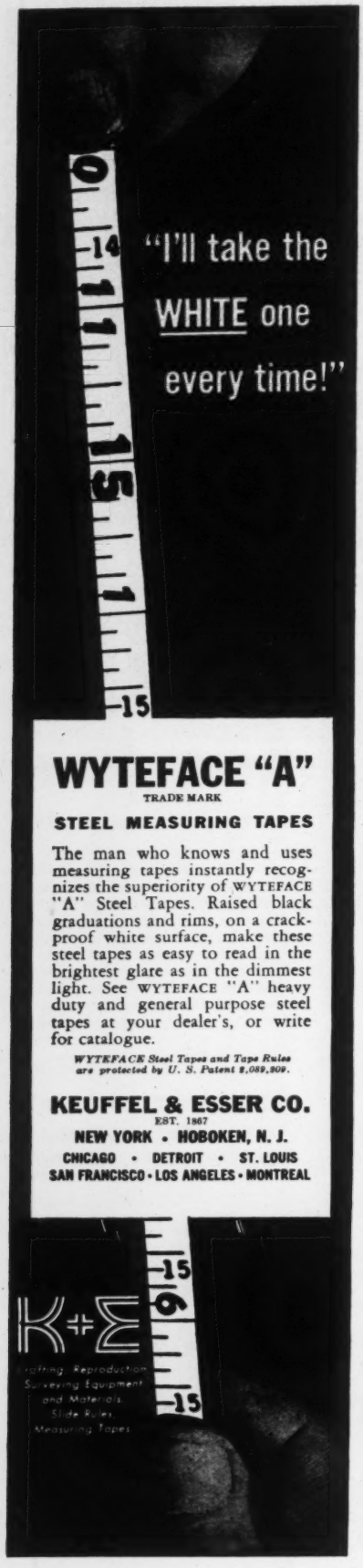
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Men and Jobs

Civilian Production Administrator John D. Small has announced the appointment of **Frank R. Creedon** as his deputy to supervise the operations relating to field activities and construction. Mr. Creedon will head CPA activities having to do with authorization of non-housing construction, expansion of the production of building materials, and channeling of materials to veterans' housing. He will supervise field construction operations and all other construction activities over which CPA has control. He will also act as liaison between the administrator of CPA and the administrator of the National Housing Agency.

Clarence A. Woodruff remains as head of the Bureau of Construction and Field Operations. **C. P. Redick** will continue as director of the Building Materials Division, which is being taken from the Bureau of Industry Operations and placed under Mr. Creedon's jurisdiction.

Mr. Creedon was graduated from the Massachusetts Institute of Technology and first entered government service in July, 1940. For more than two years he was in charge of construction for the Army Engineers and directed the government's $4,000,000,000 munitions plant program. In September, 1942, he became Deputy Rubber Director and until January, 1944, was in charge of constructing the synthetic rubber plants. From early 1944 to mid-1945 he was resident manager in charge of construction for the atomic bomb plant at Oak Ridge, Tenn.

Leaving the Manhattan Project, Mr. Creedon became special assistant to the Director of the Office of War Mobilization and Reconversion, and in March, 1946, he became deputy administrator for general disposal of the War Assets Administration.

Hubert R. Snoke has been appointed chief of the bituminous detergent and miscellaneous materials section of the National Bureau of Standards.

Joshua M. Sprague is district engineer representing the Clay Sewer Pipe Association in New York state and the Atlantic seaboard, with his office at 26 Court Street, Brooklyn, N. Y.

Norman B. Newcomb has been appointed construction superintendent of the National Gypsum Co. He has had extensive construction experience with the Port of New York Authority, Anaconda Copper Mining Co., the Phelps Dodge Corp., the Kellex Corp., and the Vern E. Alden Co. His work with Kellex included eighteen months as head of the structural division constructing the gaseous diffusion plant in Oak Ridge, Tenn., for the concentration of Uranium 235. After obtaining his civil engineering degree from Cooper Union in 1931, he studied additional structural planning courses at New York University. He taught structural drafting and mathematics at Pratt Institute, Brooklyn, from 1937 to 1940.

William Stack is construction engineer on refinery construction for the Canadian Kellogg Co., Montreal.

Col. Aubrey H. Bond recently assumed his duties as deputy division engineer for the U. S. Corps of Engineers, in St. Louis, Mo. He is a graduate of the University of Wisconsin, with a degree in civil engineering, and has been an Army engineer since 1917. During the war, he organized the Seventh Combat Battalion and the Forty-eighth Engineer Combat Regiment.

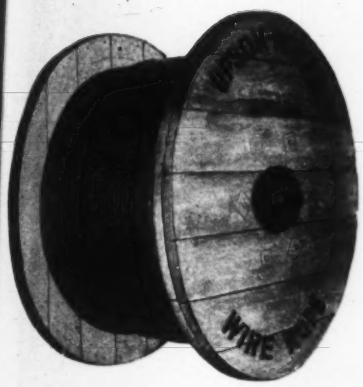
Sidney P. Lathrop, civil and structural engineer, has opened offices in Portland, Ore., at 508 Swetland Bldg. as Sidney P. Lathrop & Associates. Previously he was connected with several Portland construction companies, and during the war was on the staff of Timber Structures, Inc.

Col. William R. Shuler, Corps of Engineers, has been transferred to the Seattle District U. S. Army Engineers, as executive officer. He goes to Seattle from the Washington, D. C., headquarters of the Manhattan Engineer District. Prior to that he was executive officer of the Engineer Training Center at Fort Lewis, Wash. He is a 1936 graduate of West Point.

Roy K. Van Camp has been appointed city engineer of Tampa, Fla. He formerly was chief engineer of the Public Works Agency in Florida and later served with the PWA in Atlanta, Ga., and Washington.

Carl Funk, graduate in civil engineering, University of Illinois, started recently with C. & S. Engineering Co., Springfield, Ill., as senior civil engineer. Previous to that, Mr. Funk had been with Warren and Van Praag, Inc., Decatur, Ill., consulting engineers.

H. D. Brydone-Jack, civil engineer with the Canadian Pacific Railway for 39 years, has been appointed manager of personnel at Montreal, Que.



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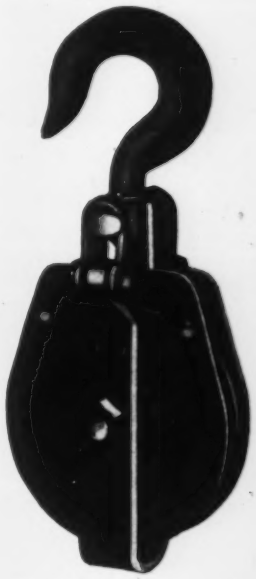

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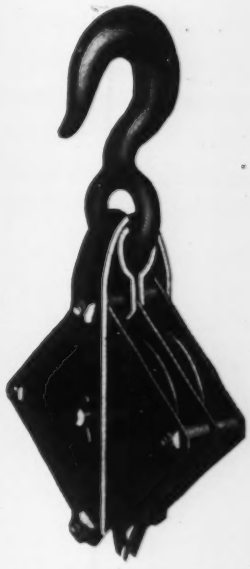

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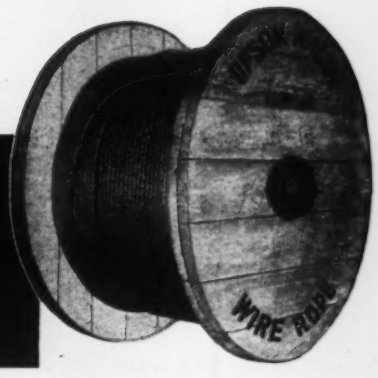

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Elections and Activities

Howard Coonley, chairman of the executive committee of the American Standards Association, has been elected president of the new International Organization for Standardization, the formation of which has just been completed by delegates from 25 nations meeting in London. Gustave L. Gerard, staff president of the Belgian Standards Association, will be vice-president of the new organization which is expected to be known informally as ISO. Headquarters will be set up shortly in Geneva, Switzerland.

Associated Engineers at Washington State College, a group of students representing all engineering departments, have elected Erick Erickson of Pullman as president, with Robert Wallace, Bremerton, vice-president; Warren Lambert, Sumas, secretary, and James Jamison, Vancouver, recorder.

Clyde E. R. Wenrich, Youngstown, has been elected president of the Mahoning Valley chapter, Ohio Society of Professional Engineers. Also elected were E. J. Salvidge, Youngstown, vice-president; Harry A. Loria, Salem, secretary; John Murray, Youngstown, treasurer; Albert Coope, Canfield, trustee for Mahoning County; Wilbur Evans, Warren, trustee for Trumbull County; and Earl Newell, trustee for Columbiana County.

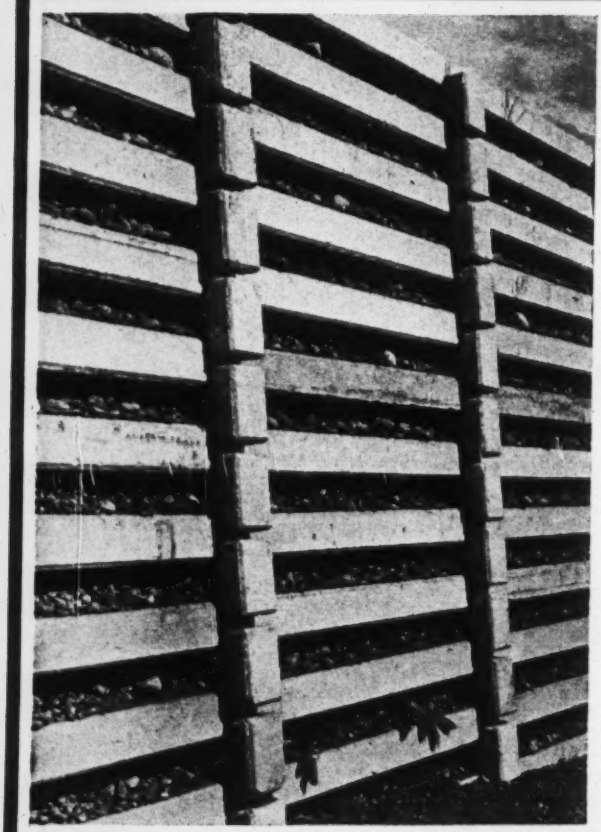
Ernest Szekely, president and general manager of the Bayley Blower Co., has been elected president of the Engineer's Society of Milwaukee, Wis., V. Robins Tate, vice-president of Perfex Corp., was elected vice-president, Chris A. Wiepking is treasurer and Henry Oman, secretary. The directors are Lloyd D. Knapp, Edwin T. Sherwood, Ralph H. Earle and R. J. Panlener.

On Nov. 4, Charles Allen Thomas, vice-president and technical director of Monsanto Chemical Co. and one of the key figures in the development of atomic energy, addressed the St. Louis, Mo., section of the American Society of Civil Engineers at a luncheon meeting on the subject, "Peace-Time Applications of Atomic Power." Robert B. Brooks, president of the section, presided, and the attendance of 125 set a record. Dr. Thomas discussed many of the peaceful or positive aspects of atomic energy as they may be developed.

A 33-minute sound motion picture, "Faith in the Future," has been prepared by Fruehauf Trailer Co. for showing to groups interested in the growth of transportation in America. The film is dedicated to the pioneers who founded the motor transport industry. It touches upon horse-drawn vehicles, boats, railways, electric lines, and finally the automobile, motor-truck, the highway system and the truck-trailer. Development of the trailer idea is depicted, as well as the processes involved in trailer manufacture, dramatic scenes of trailers at war and trailers serving war production lines. Complimentary showings of the 16-mm. film may be arranged through Fruehauf Trailer Co. branches.

The North Carolina Section of the American Society of Civil Engineers held its fall meeting at Durham, N. C., Nov. 8, the principal speaker being William M. Piatt of Durham, a director of the national organization, whose topic was "Aims and Objects of the American Society of Civil Engineers."

Officers of the section are: Mason Garber of Winston-Salem, president; R. M. Cooksey of Thomasville and R. E. Stiemke of Raleigh, vice-presidents, and George H. Maurice of Eagle Springs, secretary-treasurer.



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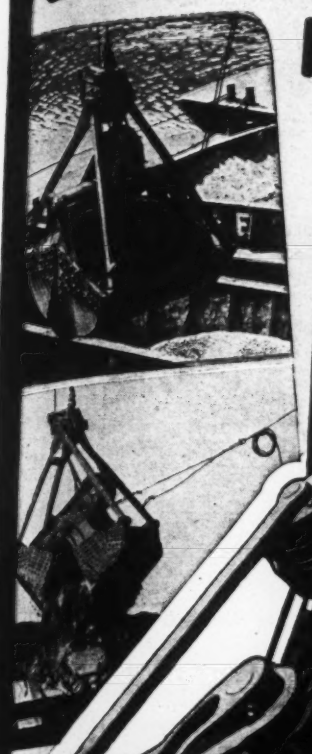

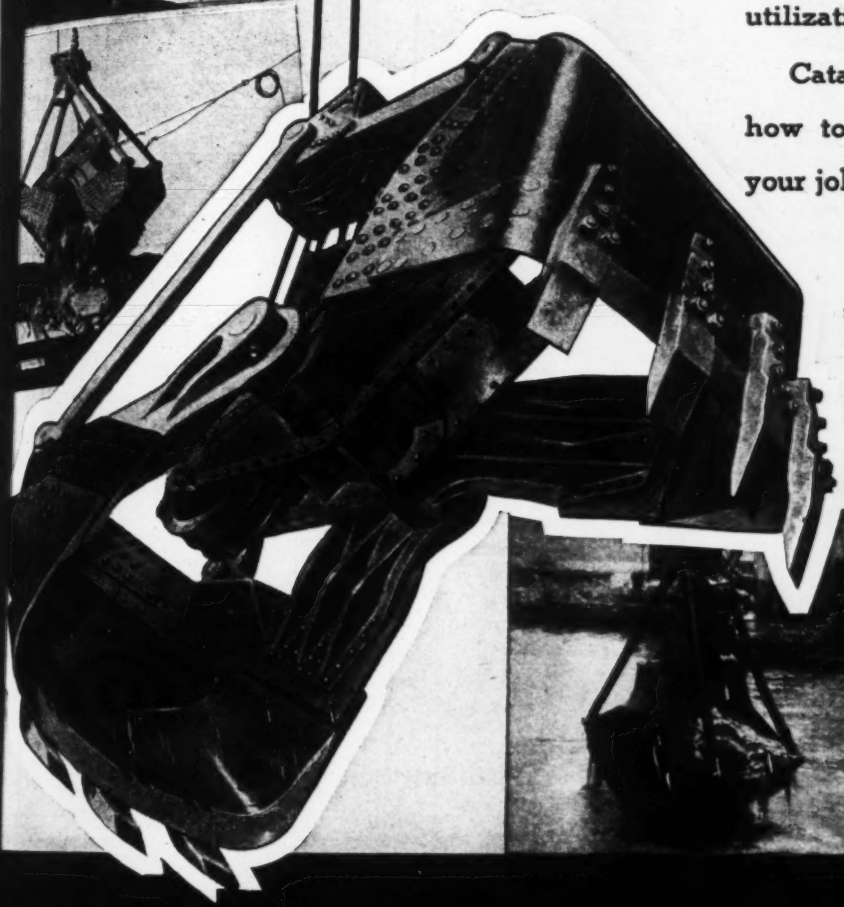

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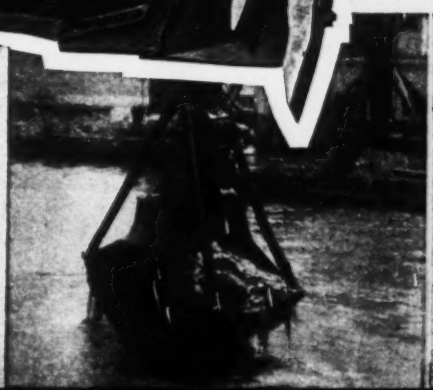

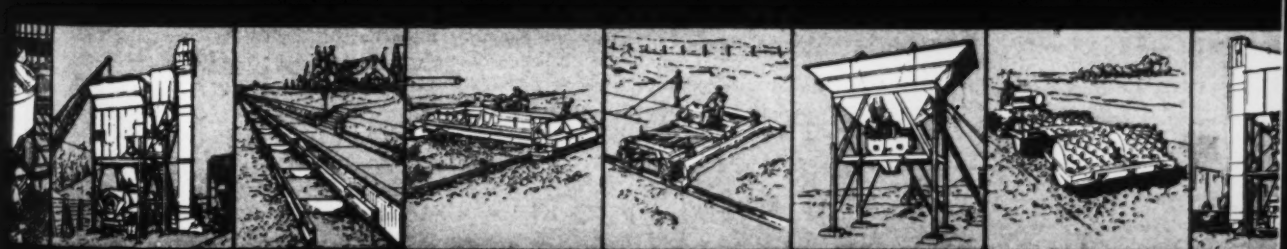

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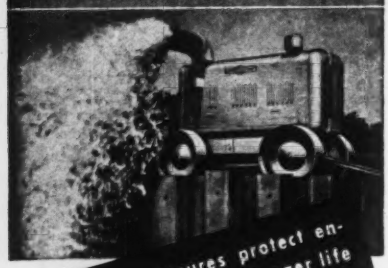

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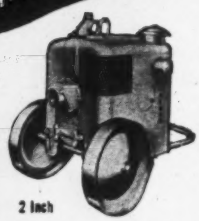

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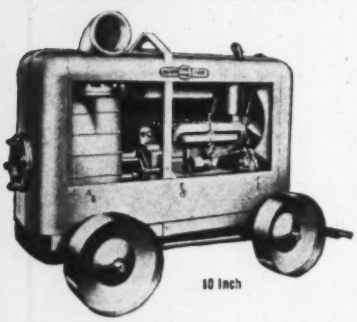

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Instant opening side panels admit to all operating controls. Enclosures are also designed to lift off or swing open for complete access when desired. One of many exclusive Jaeger advantages.

Capacities 3000 to 240,000 g.p.h.

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Manufacturers' Activities

BENJAMIN F. FAIRLESS, president of the United States Steel Corp., has announced the election of John E. Goble as president of National Tube Co. Mr. Goble succeeds Charles R. Cox, who has become president of Carnegie-Illinois Steel Corp., another U. S. Steel subsidiary. Serving as sales vice-president of National Tube company since Jan. 1, 1936, Mr. Goble has been with U. S. Steel and companies now affiliated with U. S. Steel for the last 21 years.

Marcus J. Aurelius has been elected sales vice president of the United States Steel Supply Co., Leslie B. Worthington, president of this U. S. subsidiary, announced today. Mr. Aurelius succeeds Mr. Worthington, who advanced from the vice-presidency to the presidency of the supply company on July 15, upon the retirement of Ernest E. Aldous.

William F. McConnor, general manager of sales of National Tube Co since 1936, has been elected vice-president in charge of sales of this United States Steel pipe manufacturing subsidiary, succeeding John E. Goble.

RICHARD C. HAURY has been appointed Philadelphia resident manager for The Robinson Clay Product Co. He will direct all sales activities in the Philadelphia area.

The appointment of DANIEL J. ATWELL as New England district manager for the sale of Dresser products to the water industry has been annouced by H. Z. Hight, sales manager. Mr. Atwell will cover New Jersey and all of the New England States from the New York office, 122 East 42nd Street.

INLAND HI-BOND reinforcing bars for concrete construction will be manufactured by Carnegie-Illinois and other subsidiaries of U. S. Steel Corp. under a licensing agreement recently negotiated to make the bars available in greater quantities throughout the country.

THE FOLLOWING CANADIAN SALES AGENTS for Lima shovels, cranes and draglines have been appointed: Armco Drainage & Metal Products of Canada, Ltd., Winnepeg, Manitoba; Equipment Sales & Service Ltd., Toronto, Ontario; Automotive Products, Montreal, Quebec; Dietrich-Collins Equipment Ltd., Vancouver, B. C.

Manufacturers' Publications

Tractors — (12-p. two-color booklet) Titled "A Future With a Past," this booklet depicts past methods of accomplishing heavy plowing, logging and earthmoving tasks; progress made when diesel power was introduced and advancements made in past 15 years. Tribute is paid the "firsts" in the application of such diesel power and the records of dependability and productivity they have written—*Caterpillar Tractor Co., Peoria 8, Ill.*

House-Building Machine — (16-p., illustrated brochure) Describes Tournalayer and concrete house that it constructs. It furnishes specifications and lists equipment rental costs with estimated production.—*R. G. LeTourneau, Inc., Peoria, Ill.*

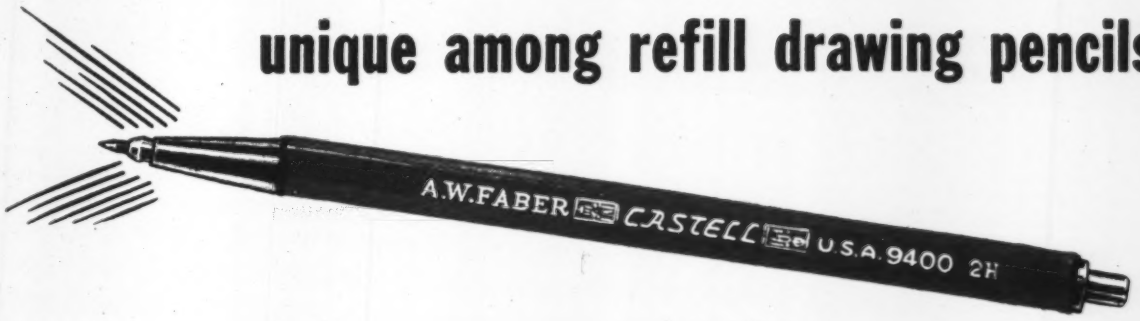
Strength of Nailed Joints—24-p. book) Written by F. J. Crandell, it presents results of investigation on types of nailed joints most used in temporary wooden structures on construction projects. A set of design rules is given for erection of these structures.—*Liberty Mutual Research Laboratory, 175 Berkeley St., Boston 17, Mass.*

Hydraulic and Air Cylinder—Believed to be first house organ in field of air and hydraulic cylinder manufacture and use, Hyd-Air is now available, free, to those interested in use of such cylinders. Engineers who specify gate control machinery for aggregate and concrete plants and similar uses will find inside information in this sheet.—*Miller Motor Co., 4027 N. Kedzie Ave., Ave., Chicago 18, Ill.*

Snow and Ice Removal — (8-p. folder) Tells why, when and how sterling auger action rock salt should be applied on highways, streets and airport runways.—*International Salt Co., Inc., Scranton, Pa.*

Mortar and Plaster Mixer—(6-p. folder) Contains close-up illustrations of features of mixer, such as adjustable scrapers and structural steel blades; sealed bearings; two-position telescopic tow pole, adjustable for either truck or car hitch; and 4-hp. air-cooled engine. Job pictures are also shown, and a table of specifications is included.—*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.*

What makes CASTELL LOCKTITE unique among refill drawing pencils?



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Particularly recommended for Architects, Artists, Engineers, Draftsmen, Designers, Photo Retouchers and other professional pencil users who appreciate ease of operation.

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Press button (1) which projects clutch and releases lead (2). Adjust lead to desired length, then remove thumb from button causing clutch to retract (3) and grip lead ¶ Every pencil marked to show the degree of lead it holds.

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Engineering School News

The Department of civil engineering of New York University announces the following new appointments to its full time teaching staff:

A. A. Warlam has been appointed assistant professor of civil engineering to teach graduate and undergraduate courses in foundation engineering and soil mechanics. Dr. Warlam will also teach highway and airport engineering and will be in charge of the soil mechanics and highway laboratories. He received his undergraduate training in the Royal Hungarian Technical University in Budapest and has received master's and doctor's degrees from the Graduate School of engineering at Harvard University where he served as research assistant for five years with Dr. Casagrande. In addition to his advanced academic training at Harvard University, Dr. Warlam has had extensive experience in highway design and construction with the state highway department of Washington and with the Hungarian Ministry of Commerce and Transportation.

Lieut. Commdr. Norman Porter, formerly with the U. S. Coast and Geodetic Survey has been appointed instructor in civil engineering to teach courses in surveying, photogrammetry, and materials testing laboratory. Commander Porter had extensive experience during the war in the Pacific theater where he served as consultant to Headquarters, III and V Amphibious Corps of the United States Marine Corps on surveying, mapping, charting, and photogrammetry. He is a graduate of the College of the City of New York.

Robert H. Cummings has been appointed instructor in civil engineering to teach courses in surveying and undergraduate courses in sanitary engineering. Mr. Cummings, a graduate of the Polytechnic Institute of Brooklyn, was with the Corps of Engineers, U. S. Army, during the war. He also completed the specialists' training in the sanitary engineering programs at Rutgers University and the University of Michigan. Prior to his war service, Mr. Cummings served as instrument man for the Board of Water Supply of New York City on the Neversink Reservoir.

Karl T. Compton, president of Massachusetts Institute of Technology, writing in 'Educational Focus," says that during the war almost every company producing war equipment was dependent in some way on technical manpower. "That this trend will continue in peacetime is borne out strikingly by a survey recently conducted among 125 companies throughout the United States by a committee of the American Society of Engineering Education. The results indicate that the future annual demand for engineering graduates will be more than twice as great as before the war."

Dr. Compton declared that the future for the young man in engineering or science is "indeed bright;" that it presents "a challenge and an opportunity that we should not and cannot let pass. "Educators and industrialists alike must do everything possible to encourage students at the secondary school level to study basic sciences. They must also develop in the students an interest in a future career in one of the technical fields."

The evening extension course in structural analysis has been reopened at the Tufts College School of Engineering by Earle F. Littleton, assistant professor of civil engineering. The program was abandoned in 1940 because of the school's cooperation with the government in the engineering defense training program.

Eighteen juniors and seniors of the college of engineering, University of Kentucky, have entered the division of design, Kentucky Department of Highways, Commissioner J. Stephen Watkins, has announced. Hours of the students, mostly ex-servicemen, will be from 4:00 P.M. to 7:00 P.M. Arrangements were made by Dean D. V. Terrill of the college and D. H. Bray, director, division of design. The men will receive hourly wages and will be under the direction of a regular senior engineer from the division.

"Besides augmenting our manpower, we hope to interest these engineering students in becoming a part of our department," Mr. Watkins said. "With the advance of highway transportation, the department will need a greater staff of trained men to take care of the increased problems of construction and maintenance."

Admission of sophomores with passing marks to the junior class will no longer be automatic at Newark, N. J., College of Engineering under a new plan that calls for the halving of the 4-year curriculum into junior and senior divisions. Upon a student's satisfactory completion of the pre-professional studies of the junior division, a diploma and the title of associate engineer will be awarded. To enter the senior division, where the professional work starts, a student will have to meet the requirements of the professional engineering departments. This year's freshman class is the first group to be affected.

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